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Be Good to Yourself at Sixty

JOHN DOE, twenty years old, spends a dollar for some trifle that affords him a few minutes' pleasure but which he could just as well do without.

John Doe, sixty years old, takes out his pencil and figures that the gratification of that whim by young John Doe cost Old John over ten dollars.

If he had put that dollar at work earning interest at six per cent, it would have increased over tenfold in that time.

And if he had added to it the many other dollars that he spent needlessly and foolishly for things that made him at sixty no better off in culture, in friendships, in social standing and in gratifying memories, he would be now in the enjoyment of a competence.

Meanwhile the possession of something to fall back upon, of an anchor to windward, would have relieved him of worry and enabled him to face conditions as they arose with independence and confidence and to have made more of his life.

"To him who hath shall be given." To one who has the means to avail himself of them opportunities are always offering to improve his condition and connections, to share in the profits of well directed industry and to enhance the earnings of his hands and brain.

I speak not in favor of parsimony or niggardliness, of the sacrifice of all that makes life pleasant and profitable and helpful and enjoyable to a narrow-minded pursuit of wealth.

The social, mental and spiritual side of one's nature needs culture, development and capitalization as much as the material, in order that at sixty one may be satisfied and self-sufficient.

Picture yourself at sixty, a man whose earning powers are failing, whose chances for employment are diminishing and whose needs are increasing. What are you doing that he may face his declining years with assurance and pass them in comfort?

AUTOMATIC CONTROL

Regulates Seventy-Two Boilers as a SINGLE UNIT

By JAMES A. INGALLS

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THERE has been considerable written on the subject of various types of automatic boiler control, laying stress on the actual mechanism and the economies to be effected. However, a point that has not received the proper emphasis is the fact that a boiler control system not only allows better control of operation and more accurate administration, but also permits changes in methods of operation that could not otherwise be easily accomplished. This point can be best illustrated by relating the experience of the Williamsburgh Power Plant Corporation, Brooklyn, N. Y., a Brooklyn-Manhattan Transit Corporation subsidiary, with an installation of boiler control equipment in its Williamsburgh power station. At the outset it should be pointed out that the seventy-two 6,000-sq.ft. boilers in a double-deck installation gave a layout that rendered administration difficult. There are eight firing aisles, four on each of the two boiler-room floors, and at no point can a boiler-room executive see the fronts of more than twelve boilers. As a result the problem of steam pressure regulation and adequate administration has been always a pressing one. In fact, a history of the boiler plant would be a story of continuous progress toward better performance.

The 72 boilers in a double-deck installation are divided into four groups, each under the control of a master regulator, and the four group masters are controlled by the station supermaster regulator.

In the early days of the plant, twenty years ago, when most of the steam was generated over hand fires, low steam was indicated by the boiler-room telegraph—"banging a shovel." The air-duct dampers to the boilers would then be opened, fires leveled and coal shoveled at an increased rate until word was passed that the steam pressure was up or a safety valve popped.

The inadequacy of this was soon realized, and a little research work, followed by actual test, showed that if the pressure in the air ducts (with air-duct dampers to the boilers open) was made an inverse straight-line function of the steam pressure, much smoother operation would result. At that time a form of damper-operating steam-pressure regulator was combined with an air bell connected to the duct and arranged to control the throttle of the blower engines. This apparatus gave practically a straight-line relation between air-duct pressure and steam pressure.

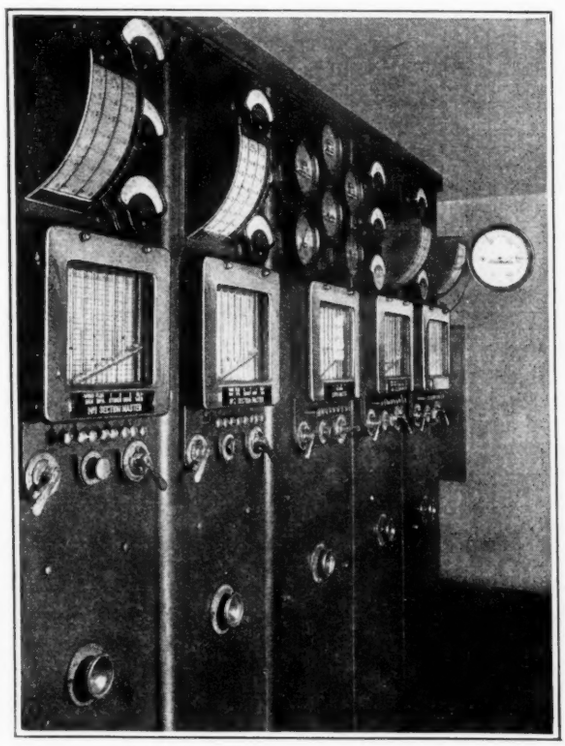
With the installation of underfeed stokers the system of regulation was continued, with the difference that a better type of damper regulator was used in combination with the air bell. This was a fairly satisfactory method of operation except that when the ratio between change in air pressure and change in steam pressure was made too sensitive, the steam pressure would hunt. On the other hand, a ratio that would not cause hunting would allow too much drop in steam pressure before the load could be carried. Remedies for this condition were only partly satisfactory. Furthermore, responsibility for the steam pressure had either to be divided between the two boiler rooms or given over to the boiler-room engineer on one floor, who could not, from the very nature of things, have sufficient knowledge of conditions to supervise properly the plant's operation.

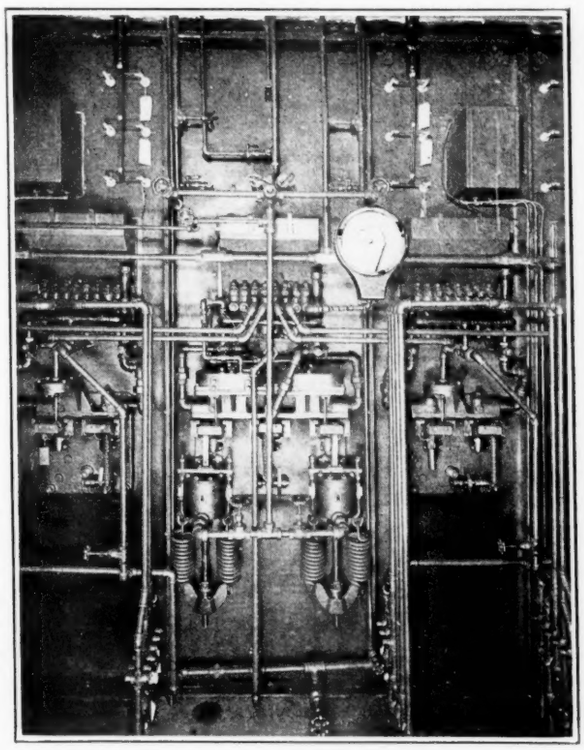
It had been long recognized that a central control room with adequate control, instrument and signal equipment was necessary. However, the problem of arranging locally designed equipment to control air-duct pressure, stoker-shaft speed and flue-damper position, as well as to compensate for the irregularities of individual fires, was both costly and time consuming and without the certainty that the equipment would be entirely satisfactory when designed and installed.

A further objection lay in the fact that there was no place for a control room, all existing space in the boiler room being occupied. When, however, as will be seen later, it was decided to purchase control equipment, a space for a control room was created by cutting a hole in the division wall between the boiler room and turbine room and projecting part of the control room as a glass-inclosed balcony out into the turbine room. This was a happy solution, since natural light from the turbine room as well as a view of the turbines and turbine-signal annunciator was then available.

Early in 1925 a small test installation, using equipment manufactured by the Smoot Engineering Corporation, was put in service, and tests made not only to determine the efficiency but also the practicability and flexibility of operation. It then was apparent that this equipment not only made satisfactory steam-pressure regulation possible, but offered possibilities in the way of attaining the highest economy with the existing boiler and stoker equipment. The complete installation was finished in July, 1926.

This equipment consists of 180 regulators for fuel, air supply and draft control on the 72 boilers, all under the control of four section-master regulators and a supermaster regulator. The master regulators and the necessary metering equipment are in a central control room, so that the operation of the entire boiler plant is under the supervision of one man. The control-room equipment is shown in Figs. 1 to 4.





Figs. 1 and 2—Front and rear views of the four group masters and supermaster Smoot regulators in the control room, from where the 72 boilers are controlled

As shown in the upper-floor plan, Fig. 5, the boilers are arranged in rows of six each, forced draft being supplied to each row by a long duct with steam-turbine-driven blowers at either end. Power for stoker drive is transmitted by a shaft running the length of each row. Connected to each shaft through spur gears, chain drive and clutches are two engines, either of which can be used. As these two engines are set side by side, their speed is regulated by one speed governor under control of the section master in the control room. However, in case of the two blower turbines, these are separated by too great a distance and to each is attached a regulator, governing the air pressure in the duct as called for by the section master. On each boiler are two regulators. One of these, on the windbox damper, is known as the air regulator and the other is on the flue damper and is governed by the draft over the fire.

Three rows of boilers, constituting one-quarter of the boiler equipment, are grouped together as a section under the control of a section master. Each of the four section masters has a mercury-tube indicating column for all blower regulators and one tube for all windbox dampers in a section. However, as a row of boilers is the usual unit of operation, each stoker regulator is under the control of a single tube, so that the stoker-shaft speed on any row of boilers may be separately adjusted. Shut-off cocks are in each control line at the regulators, so that in case of a control-air leak developing the trouble can be quickly segregated.

All regulators are mounted on brackets set in or near the floor, so that they are all easily accessible from the operating floor. This has largely reduced the labor of adjustment and repair. All regulators are so arranged that by removing four bolts and breaking conveniently located pipe unions, the whole regulator can be lifted out and replaced by a spare. As it actually worked out, the repairs necessary to date have been of such a simple nature that this has not been necessary. In Fig. 6 can be seen a stoker-speed governor regulator *R*, the stoker engines being below the operating floor. In the background is an air regulator *A* in front of a boiler and controlling the windbox damper. Regulators controlling the stack dampers are not shown in the photograph but they are also mounted conveniently for access.

It might be remarked that it is believed that this installation with a total of 180 regulators is the largest plant in point of number of regulators and of the number of boilers under automatic boiler control. It is obvious,

with an installation of this size, that nothing should be left undone to simplify and reduce the labor of maintenance. In fact, with this in mind a special workbench and a tool cabinet for all the necessary tools and spare parts were set aside for the exclusive use of the control maintenance men.

Following out the same idea, all piping back of the panels in the control room (see Fig. 2) was arranged to give ready means of access to all parts.

Oil under 125-lb. pressure is the motive power operating the pistons of the regulator. The mineral seal oil used has a low cold test and viscosity and a high flash and fire test. The oil pressure is maintained by two two-stage 200-g.p.m. centrifugal pumps, either of which is amply sufficient to operate all the regulators. Air for the control is taken normally from the station air supply. If this falls below 75 lb. an emergency steam compressor starts and, in case of failure of this compressor, there is an electrically driven compressor that starts when the pressure drops to 60 pounds.

The four section master regulators are under control of a supermaster. The supermaster has two independent steam control elements with adjustable compensators, and each one is normally used on alternate days, but with the idle one ready for immediate service at the turn of a throwover valve. There is also a means of throwing out the automatic regulation and substituting control from a handwheel.

Four columns on the supermaster indicate the loading pressure that is being maintained on the four section-master panels. The loading is normally alike on all four section masters, but the relative loading of any section master, as indicated by the corresponding mercury column in the supermaster, can be varied at will. If it is desired that any group of 18 boilers under the control of a section master be driven at a different rate of steaming than the others, the adjustments can be readily made at the supermaster.

Each section-master panel can be cut clear of the supermaster panel and adjusted by a spring-loading device to any desired steaming rate.

The upper parts of all section and supermaster panels were left vacant by the manufacturers for the installation of instruments. As will be seen from the photograph, Fig. 1, the air-duct pressure and the stoker speeds for each row are indicated on the section-master panel which controls them. Bailey meter-type draft gages are used for the former and Weston magneto-type tachometers for the latter indication. The panel of the supermaster mounts six gages, giving the main steam pressure at two points, the feed-water pressure, the oil and the air pressure for control, as well as the steam pressure on the emergency air compressor. There are also indicating lights to show if power is available on the stand-by electric air compressor and whether it is in operation.

In addition to the aforementioned meters a large illuminated steam gage gives the main steam pressure acting on the supermaster regulator element in service at the time. There are also twelve recording draft gages, Fig. 3, on the air ducts, as well as recording pressure gages on the main steam control air and control oil, and a gage that records the air-duct pressure called for by the supermaster, shown in Fig. 4.

To allow of proper communication, a simple bridging telephone system, having connections corresponding to the four sections of the boiler room as well as to the pumproom, has been provided. This, however, only supplements the signal system, which consists of a group of three colored signal lights, red, white and green, in each firing aisle and eight Klaxon horns. By means of different, easily remembered, combinations of these lights, four emergency signals, "Control Off," "Low Steam," "Station Out A.C." and "Trouble—Stand by," are transmitted. By use of other color combinations, together with a single or a double blast of the horn, it is possible to summon any one of the four assistant boiler-room engineers or either of the two boiler-room engineers to the telephone.

During the work of installation, as the regulators on a row were connected and adjusted they were put into service. During this period great care was used to prevent any possibility of the apparatus failing, and in this manner planting an element of distrust in the minds of the rank and file of the operating force. Up to the present no operating difficulty has been experienced as a result of failure of the control equipment itself. Early in the installation two failures occurred due to the compressed air supply being shut off when the apparatus was wholly dependent upon the station air supply, but even this chance has been eliminated by the automatic

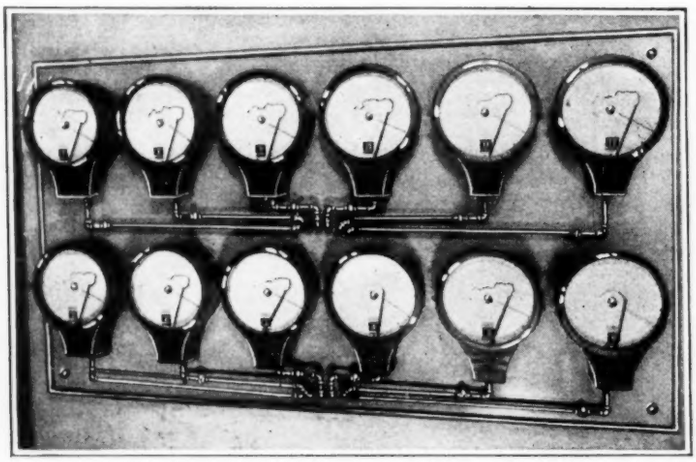


Fig. 3—Recording pressure gages on the air ducts

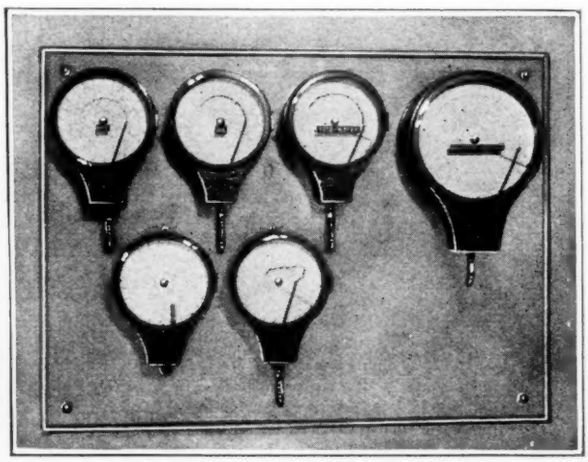


Fig. 4—Supermaster pressure gages

cutting in of a steam and an electrically driven compressor in case of failure of the station air supply.

It was rather gratifying to observe the mental attitude of the boiler-room attendants change from veiled hostility and suspicion to tolerance and finally to confident acceptance. The fact that one row of boilers after another was cut in as the installation was completed, helped matters materially by making the introduction more gradual.

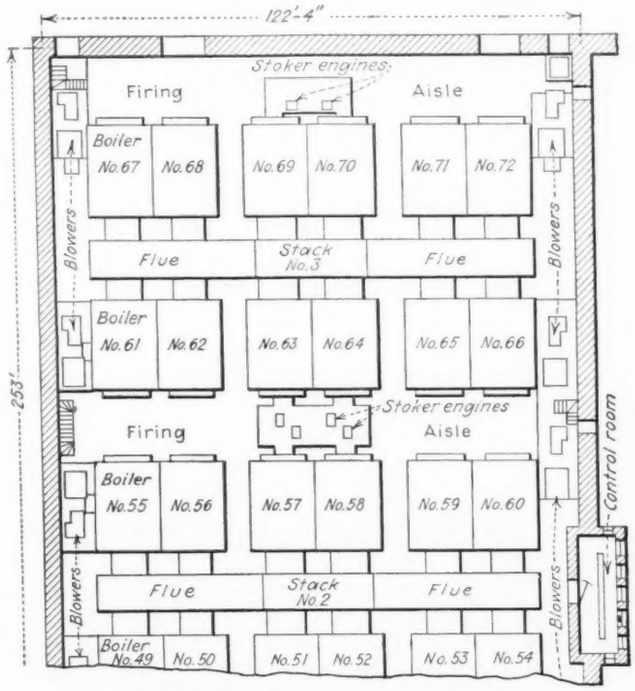


Fig. 5—Part of the upper boiler deck layout

In one sense the system has not been labor saving, in that by the installation it was possible to cut down the number of the operating force. In fact, the installation has required the undivided attention of one man on each watch in the control room, supplemented by two repair men on the day watch to take care of maintenance.

The men now relieved from the regulation of dampers, stoker speeds and blower pressures, have been able to turn their attention more to the care of the fires and proper stoker operation. Another result of the installation has been the elimination of banking during periods when it had been looked upon as a necessary evil.

It had been recognized before using the boiler control that, by careful handling of the fires, it was possible to keep a boiler in service at less than normal rating and that this was more desirable than banking. In practice, however, the lowest practical output during average operation was approximately 125 per cent of rating. By using boiler control and by redesigning the stoker engine gear ratios, an output of 75 per cent of rating or less is now carried smoothly in low-load periods so that banking is resorted to only between evening and morning peaks. During the night period also banking is largely reduced. This low load could possibly have been carried without the boiler control, but not at high efficiency.

A problem of operation that had never been satisfactorily solved was the preparation of boilers to take the morning rush load, which built up very quickly. Before the load came on, the number of boilers that could be started up from bank was limited by the fact that, with the limit for the lowest practical capacity set at 125 per cent of rating, more steam would have been generated than could be used. On the other hand, boilers cut in and rapidly put on heavy load after an all-night bank would smoke and blow the fuel bed apart. Rapid feeding in of an excess of coal to remedy the latter was an unsatisfactory and inefficient solution, and this also rendered cleaning the fires difficult.

The possibility of operation at less than rated capacity enabled most of the fires to be brought up at a more gradual rate. This reduced smoking and gave better and more even fires with more economical operation. It took, however, a practical demonstration to give assurance that overspeeding of the coal feed, prior to the rush periods, was not necessary to carry the load. In fact, without boiler control it would have taken considerable administrative effort to stop the practice of overfeeding coal and to prevent a relapse to the old methods as soon as vigilance was relaxed.

Furthermore, the control operator, with ample instrumental evidence as to the proper time to cut in boilers, is now able to signal for boilers as soon as they can be carried. This superseded the old way, where the operator had not only to work fires into shape, but to keep watch on the steam gage and cut in boilers fast enough, but not too fast, for the increasing load.

Another problem was that of maintaining proper stoker speeds, particularly on rising or falling loads. Even with the more conscientious of the operators the speed adjustment was made in steps and did not follow the load very closely. At present, while the assistant boiler-room engineers may ask for a modification of the ratio between coal feed and air, the actual change is made in the control room by the control operator. Furthermore, the deviation from the normal must be small, and this ratio, as set, is maintained at a constant value over a wide range in load.

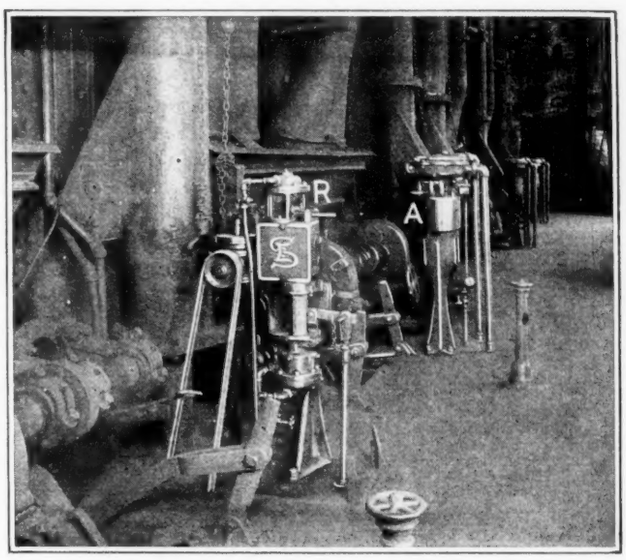


Fig. 6—Stoker-speed regulator at R and windbox damper regulator at A

Previous to the use of boiler control the load could not be evenly distributed between the different rows of boilers. During the heavy-load periods this resulted in some boilers carrying more than their share with resulting damage to grates, brickwork and boiler fronts. With boiler control this has been reduced to a minimum.

During the early period of using the control system, the point was often raised that certain of the boilers under regulation would not carry the load even with the

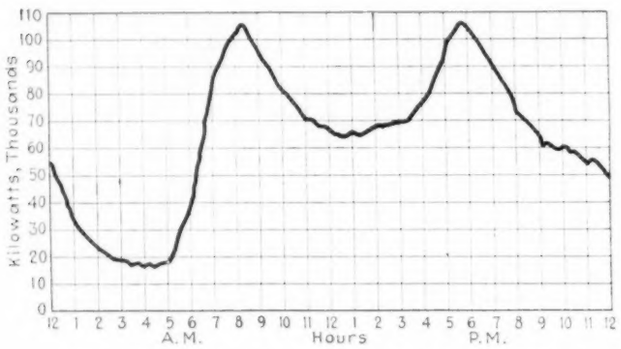


Fig. 7—Station load curve for August 30

fires in good shape. When investigated, these cases often revealed that the boilers showed an accumulation of clinker formation on the first pass tubes. This increased the loss in draft and acted on the regulator as would an excess of air, which resulted in the regulator reducing the

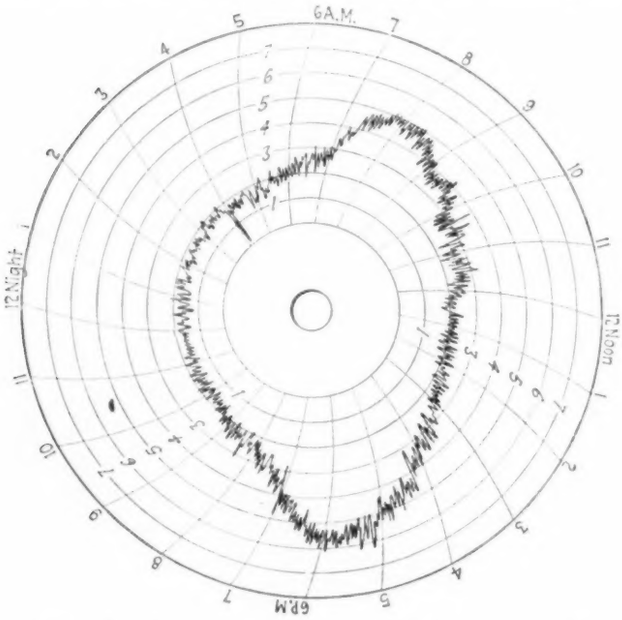


Fig. 8—Air-duct pressure record for August 30

Note how the air-duct pressure varies with the load, Fig. 7, the maximum duct pressures occurring simultaneously with the peak loads.

air supply. More frequent and improved methods of cleaning removed this objection.

In other cases, where regulators on boilers would not allow them to carry load, the reason was found to lie in defective dump grates, which, when unsealed, allowed excess air to enter the furnace. Remedying these defects cured the trouble.

It is interesting that, in these cases, in order to obtain proper output it was necessary to improve the efficiency. It might almost be said that, to carry load, it was necessary to do it efficiently.

As has been the station practice for some time, daily observations and gas analyses of all boilers in rotation are made by men from an organization separate from the operating force. These reports are immediately available, and the reason for low CO_2 or the appearance of more than a trace of CO is made the subject of an investigation. This results in immediate repair or adjustment of the regulator or, as is more often the case, scheduling repairs or other work on the boiler or stoker.

Further, in regard to maintenance work a six-months interval inspection and cleaning of all regulators is practiced. In the case of draft connections to the boilers,

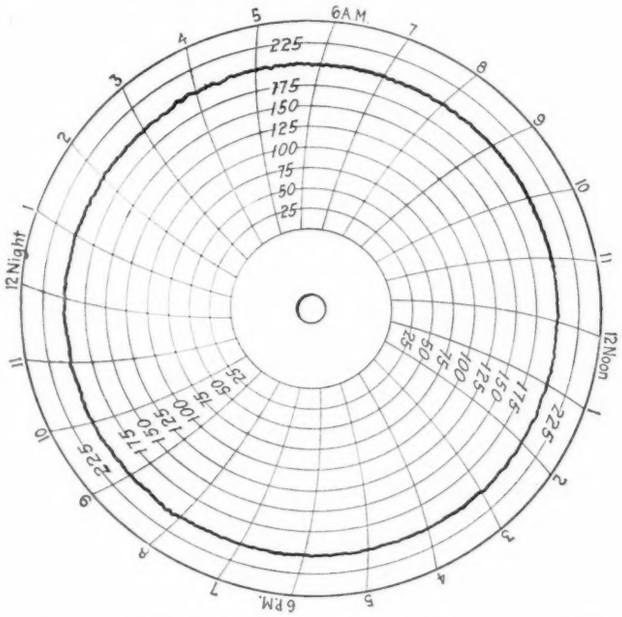


Fig. 9—Station steam pressure record for August 30

Although the load on the station varied between 18,000 and 106,000 kw. the steam pressure changed only about three pounds, plus or minus, during the 24-hour operation.

this is followed up on a two- or three-day schedule depending upon conditions and the urgency of other than routine inspection and maintenance.

Since the installation of the control equipment there has been no case where the station has dropped out under heavy load. However, on Armistice Day, 1926, the load suddenly dropped from 80,000 to 26,000 kw. and after a few minutes came back to approximately the previous value. During this time the boiler control handled the situation without the slightest assistance and held the steam pressure with a deviation of only five pounds above and below normal.

With regard to efficiency the equipment can be said to have lived up to the expectations that were based on the preliminary tests. In fact, the present high efficiency of the boiler plant could not be consistently obtained without it. But, without depreciating these economic results, the real appeal of the equipment for the operating men is the freedom from the many petty exasperations and cross purposes which are inescapable in a situation where a number of men are all trying in good faith to attain a common objective, but lack a means of co-ordinating their efforts.

Direct-Fired Powdered-Fuel Boilers with Well-Type Furnaces at the Charles R. Huntley Station*

By H. M. CUSHING† and R. P. MOORE‡

THE 1926 Extension to the Charles R. Huntley Station at Buffalo includes the addition of four 12,500-sq.ft. boilers, each with water-cooled furnace walls and 76 per cent economizer surface. The paper describes the evolution of furnace design, reasons for selection of pulverized coal, adoption of the direct fired system and the operating results. Tests embodied in the paper show unit efficiencies in excess of 85 per cent within the operating range of the equipment from 125 per cent to 550 per cent of rating of boiler and walls.

THE duty imposed on a steam generating plant operating in conjunction with a large hydro-electric system is characterized by a wide variety of requirements. The station must not only be capable of handling base load at reasonable efficiency when system conditions demand, but it must also supply highly dependable stand-by service, which means periods of low-load factor operation and the ability to pick up load quickly in emergency. Such a problem is presented in the Charles R. Huntley Station of the Buffalo General Electric Company, operating on the Buffalo, Niagara & Eastern Power Corporation system.

In designing the extension to the station, there were several outstanding requirements to be met which placed definite limits on possible arrangements and selection of equipment. In the first place, the extension was to include a 60,000-kw. turbine together with sufficient capacity in the boiler house, with a unit to spare, to supply this turbine. In the second place, the new equipment was to be placed in an addition to the then existing power plant. This led naturally to continuing the same floor levels and column spacings, resulting further in the selection of boilers the same size as those in the old plant and for which the building was designed. After recognizing these fundamentals, the question then became, "How many boiler units should be installed to take care of the 60,000 kw., requiring 670,000 lb. of steam per hour under the steam conditions existing at the station?"

The plant is, fundamentally, the peak load and stand-by unit of the system. The base load is carried normally by the hydraulic plants at Niagara Falls. Previous to the design of the extension the station had been carrying only the peaks of the weekday load, keeping one machine in operation as stand-by during the nights, on Saturday afternoons and Sundays. This resulted in low annual station capacity factors. Station peaks were of short duration, lasting not more than a few hours a year. These features of the load pointed to the minimum of investment and the operation of equipment at high ratings.

The old boiler house contained 12,515 sq.ft. cross-drum boilers, with 9,435 sq.ft. cast-iron economizers. Eleven of the boilers were fired with duplex stokers and the remaining one with a long single stoker. The maximum practical capacity from one of these boilers was about 130,000 lb. per hour actual evaporation.

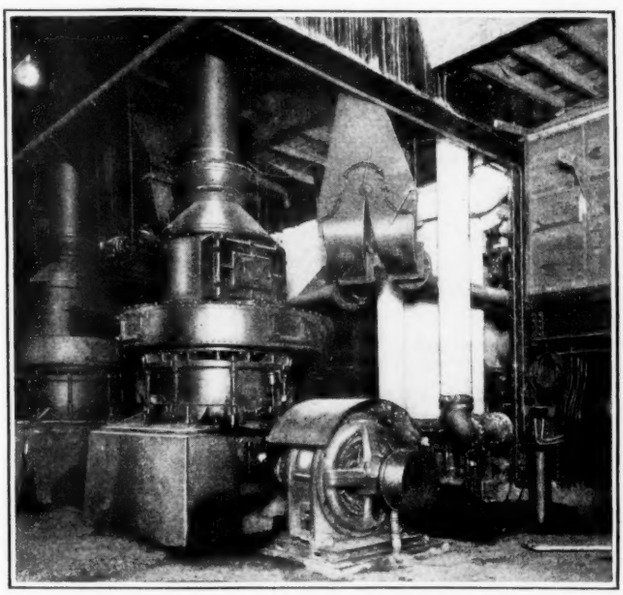


Fig. 1—Mills and feeders for one boiler
Note the distributor for the coal and primary air above and to the right of the nearer mill.

*Abstract of paper presented at the First National Meeting of the A.S.M.E. Fuels Division, St. Louis, Mo., Oct. 10 to 13, 1927.

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‡Mechanical Engineer with Buffalo General Electric Company.

The obvious answer to all the stated considerations was to increase the maximum boiler output in the new extension over that obtainable in the old plant, the physical dimensions of the boiler being determined as already stated. No reason except efficiency could be found for holding the maximum rating of the boiler down to values commonly used. Careful study of this point showed that there was no justification for holding the capacity below that corresponding to the maximum quantity of fuel it would be possible to burn under the boiler. Comparing pulverized coal firing with stoker firing, it was felt that the former would help as far as capacity was concerned and be particularly valuable for quick starts and stops. However, the cost of a coal preparation plant and the furnace volume usually considered necessary at that time argued strongly against it. The use of direct firing of the powdered coal and the turbulence produced in the furnace by the well type of furnace construction promised to overcome these two difficulties, and the use of powdered coal was finally decided upon. With this equipment it was felt that the maximum capacity of the boiler unit could be increased to the 225,000 lb. per hour required if the new unit were to be supplied by three boilers. Accordingly, four boilers, one a spare, were added in the extension; but because of many novel features in the design one No.

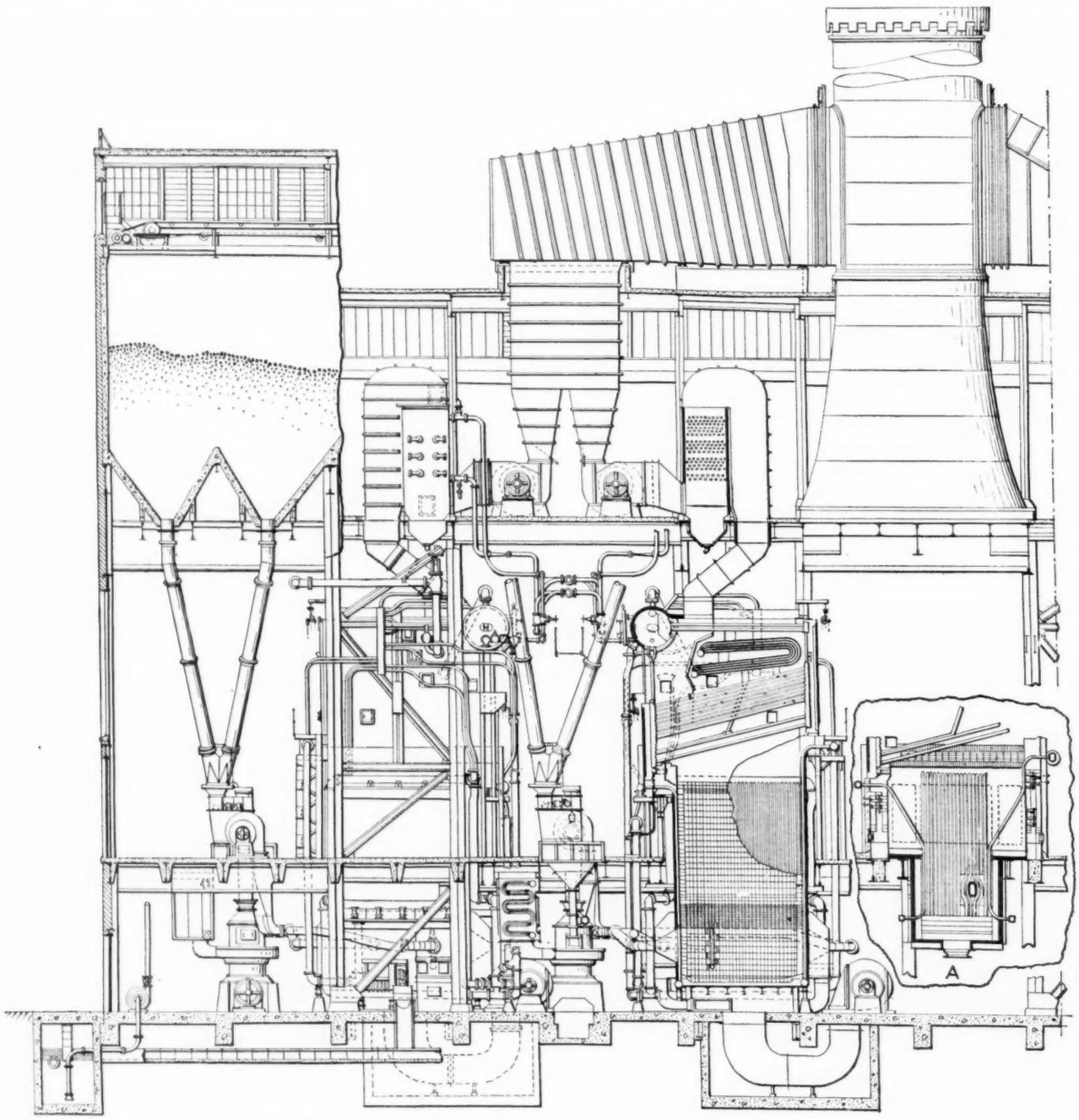


Fig. 2—Longitudinal section of boiler house 1926 extension
Partial section of No. 13 boiler at A.

13 was rushed to completion to determine the limits of this type of furnace.

The boilers themselves are practically duplicates of the older ones in the plant. They are of the horizontal-tube, sectional-header, cross-drum type, 44 tubes wide and 11 tubes high not counting the circulators. They are equipped with three-pass superheaters, located in the overdeck position and designed for 275 deg. superheat. They are baffled for three gas passes with sloping baffles between the first and second passes. The total water heating surface of each boiler is 12,515 sq.ft., and the superheating surface is 7,100 square feet.

The furnaces for the four boilers are of the well type, but they are of two different designs, or rather, three are developments from the tests of the first one. The furnace layout for boiler 13 is shown at *A* in the cross-section of the plant Fig. 2. It consists primarily of a well, 8-ft. square, composed of 3¼-in. tubes spaced on 6-in. centers. Above the well the tubes of each wall continue parallel to each other, but flare out and pass through the brick walls of the furnace just under the boiler proper. This gives a furnace volume of 5,076 cu.ft. between the furnace wall tubes and below the boiler tubes, of which 682 cu.ft. is in the well. The group of tubes on each side of the well is connected top and bottom through headers to the boiler drum. No provision is made for recirculation. The walls are of hollow construction, with arrangements for tertiary air cooling. Secondary air comes from a fan that discharges into an air space around the outside of the well. There is one burner in each of the four walls of the well, offset two feet from the center so that the velocity of the jet causes cyclonic action and turbulence of the gases in the furnaces.

The other three furnaces, boilers 14, 15 and 16, as shown in the cross-section Fig. 2, are composed of four water walls with refractory-faced blocks extending down from the boiler to within a few feet of the basement floor. There is practically no brick exposed in the furnace. The lower section forms the well, which is 15 ft. 7 in. square and 7 ft. 6 in. deep. Above this the two sides extend outward to the full width of the boiler, giving a total furnace volume of 10,200 cu.ft. The exposed block surface amounts to 2,044 sq.ft. per boiler. Each water wall has its separate recirculation through external piping. The furnace bottom is flat. It is composed of two courses of firebrick on a steel plate. A 6-in. layer of burned Dolomite dished up at the sides is spread over the brick. Below the furnace bottom is a plenum chamber for secondary air. The coal and all air required for combustion are admitted through four burners, one in each water wall. These burners are offset four feet from the center line. They are of the Calumet type, in which the opening for coal and primary air is 5 ft. in height by 2.4 in. across.

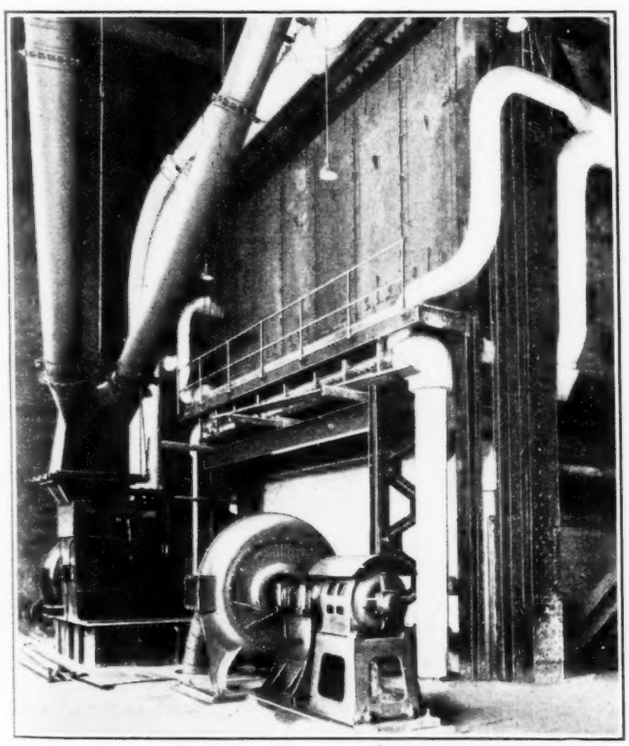


Fig. 3—Boiler with larger furnace at boiler room floor level showing automatic scales and mill exhauster

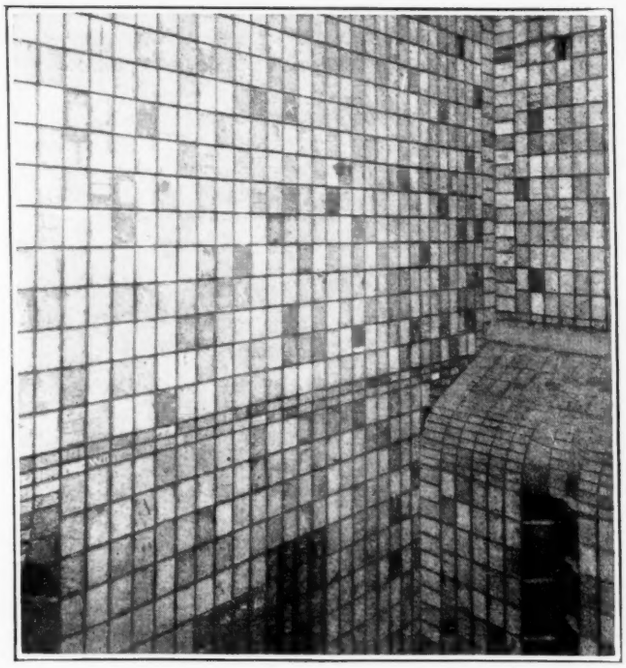


Fig. 4—Interior of larger furnace before firing, boilers Nos. 14, 15 and 16

No attempt is made in the furnace to chill the ash before it settles. On the contrary, with the design of furnace just described, it is important that it be maintained in a molten state until such time as it may be tapped off. Because of this, the furnace may be operated at temperatures limited only by the effect on the water-cooled walls. This permits of higher rates of combustion per unit volume and, what is also important, the use of low fusion ash coals.

The handling of the molten ash originally presented a problem which has been solved in a simple way. The slag tap hole has a cast-iron spout which discharges onto a high-velocity jet of water in a cast-iron housing known as the disintegrating box, which continues as a sluicing system under the basement floor. This sudden cooling action shatters the slag into a granular product about the size of coarse sand, together with a consider-

able quantity of spun slag. The sluice discharges into a sump pit, from which the slag and water are pumped by 6-in. dredge pumps to a point where it may be loaded on cars.

There are two 48-in. vertical air-separation ball mills per boiler rated at eight tons each. These ball mills are used as unit mills for direct firing. A combination

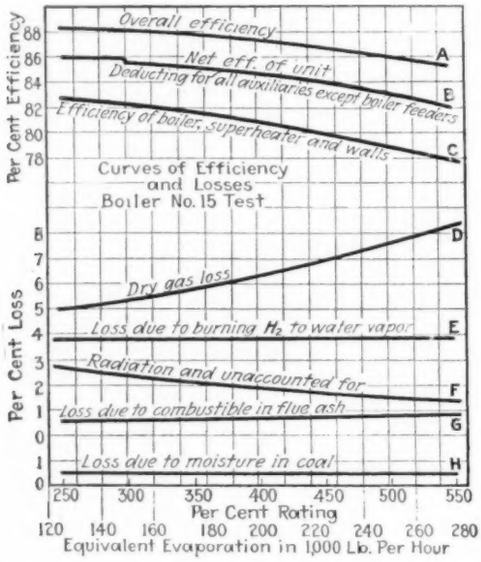


Fig. 5—Curves of efficiency and losses—Boiler 15 tests

of mill and exhauster supplies coal and air to two burners located on opposite sides of the well furnace. The other mill and exhauster supply the other two burners. This permits single mill operation if it is desired or required because of trouble on the other equipment.

A high-pressure steam heater has been provided for preheating the primary air. It is intended for use only when excessive moisture in the coal limits the output of the mills below the ratings desired.

Evolution of Design Boiler 13

The trials on No. 13 involved a variety of air admission and burner arrangements. While some runs were made with a view to learning the efficiency, the boiler was operated mostly at high ratings to determine life of materials, etc. First, the well was lined with bare-faced calorized steel Bailey blocks. Spaces were left between the blocks for admission of the secondary air. The burners were hollow walled nozzles having an 8x9-in. opening and provision for water cooling. The flue-gas temperatures under these conditions, measured at this boiler outlet, were exceedingly low, being 580 deg. at 225,000 lb. per hour actual evaporation. Although no exact measurements could be made, it is estimated that 50,000 lb. of water per hour was evaporated in the tubes of the well, when the boiler proper was doing 100,000 lb. per hour. This is based on temperature measurements of the steel wall blocks in the well. There was no appreciable slag accumulation on the tubes of the boiler. However, considerable smoke occurred with this arrangement at high ratings which represented an appreciable unburned combustible loss. The steel blocks also burned rapidly in certain parts of the well.

The next move was to replace the calorized steel blocks with refractory faced blocks. The burners were also exchanged for air-cooled burners having a long narrow coal opening 4x33½-in. with provision for the secondary air to enter on each side. At this point improper distribution of the coal between the burners became evident as being partly responsible for throwing down coke in the well. This could not be corrected merely by dampers, as an improper distribution of air would result, which would be just as serious. A distributor, therefore, had to be devised which would split the coal and air from each exhauster equally to both burners. When this had been done, the efficiency was improved.

The next step was to install an air preheater for the primary air, so as to take care of wet coal from yard storage. Changes were also made in the baffling of the air separation mills to improve the fineness of pulverization. The result was a further increase in efficiency. Subsequent tests with and without the preheater led to the conclusion that the gain in efficiency was almost entirely due to finer grinding.

From this point on, various arrangements were tried. Exposed tubes, where blocks had been burned away, had showed no grief even after a considerable period of service in the well, when 62,000 B.t.u. per hour per cubic foot of furnace volume were being liberated. This led to trying carborundum blocks attached to the back of the tubes on one wall of the well. Blistered tubes resulted after a short period of service. Other arrangements were tried in which the sloping tubes were more or less covered. In general it may be said that

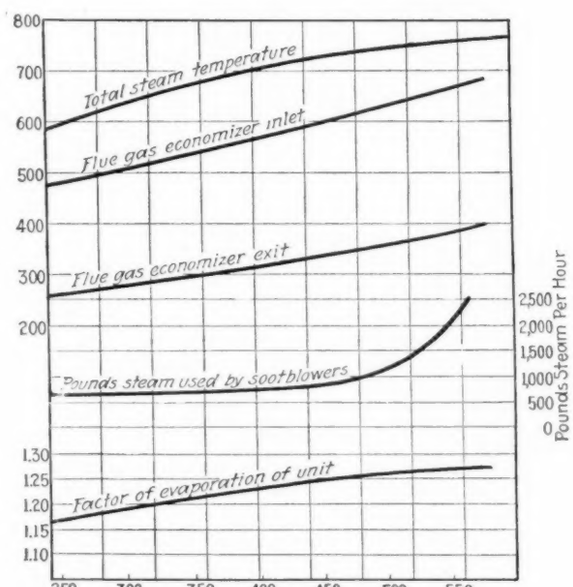

Total steam temperature
Flue gas economizer inlet
Flue gas economizer exit
Pounds steam used by soot blowers
Pounds Steam Per Hour
Factor of evaporation of unit
Per Cent Rating
Equivalent Evaporation of Unit in 1,000 Lb. Per Hour

Fig. 6—Flue gas temperatures, quantity of steam to soot blowers and factor of evaporation—Boiler 15 tests

the more they were covered the less the smoke but the greater accumulation of the slag on the tubes of the first pass. The point in rating at which smoke appeared was definite for any particular amount of exposed tube surface. The furnace is sensitive to the proper distribution of air and coal, and if the adjustments are not just right, coke is thrown down in the well.

The important conclusion to be drawn from the trial on No. 13 boiler was that the unit as built was satisfactory for actual evaporations up to about 150,000 lb. of water per hour, which corresponds to 31,200 B.t.u. per cu.ft. effective furnace volume. Above this rating the life of the wall blocks is too short, but good efficiencies without smoke may be obtained up to 200,000 lb.

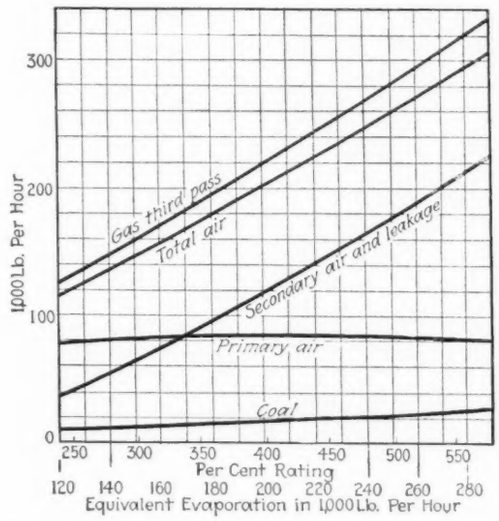


Fig. 7—Quantities of coal, air and gas—Boiler 15 tests

per hour actual evaporation. As it was necessary to obtain evaporations of 225,000 lb. of water per hour to meet the design requirements, it was decided to increase both the size of the well and total furnace volume, and the design already described for the other three boilers resulted.

Operation of Boilers Nos. 14, 15 and 16

As to capacity, these boilers have often exceeded 275,000 lb. per hour actual evaporation for short periods of time. No difficulty whatever is experienced in maintaining an actual output of 250,000 lb. per hour indefinitely. They have also proved themselves particularly valuable for making quick starts and stops.

The ash pool on the furnace bottom is tapped about once in 24 hours if the boiler has had any appreciable amount of service in that time. The boiler must, of course, have been in service some time when it is tapped. Any quantity up to fifteen tons has been drawn off at one tapping. The percentage analysis of this slag ash is as follows: Silica, 44.52; aluminum oxide, 18.64; iron oxide, 31.25; titanium oxide, 0.76; phosphorus pentoxide, 0.25; calcium oxide, 1.33; magnesium oxide, 1.10; sulphur trioxide, 1.80; undetermined, 0.25.

Operation of the new plant has not been for a sufficiently long period of time to permit the accumulation of any data on maintainance, but there are no indications that there will be excessive or unexpected items in this part of the operating cost.

Even at the high outputs there is no difficulty in maintaining 16 per cent CO_2 with nothing more from the stack than the white smoke that is characteristic of good powdered coal firing. Under these conditions an indicating pyrometer has shown a temperature of 2,900 deg. F. when pointed into the fire near the bottom. The flame from the four burners makes excellent use of the furnace volume, accounting, no doubt, for the high CO_2 possible without CO and for the volume rate of combustion obtained. At 250,000 lb. per hour actual evaporation, the heat liberated is 37,400 B.t.u. per cu.ft. of the furnace.

Besides the wide range of capacity possible with these boilers, which extends from 60,000 to 275,000 lb. per hour, there is great flexibility possible in the way they may be operated. Frequently, only one mill has been used and in this case the secondary air has been supplied by either the other exhauster or the secondary air fan or both. Using only one mill, a continuous output of 200,000 lb. per hour has been maintained for twelve hours with an average efficiency of 83 per cent. It is also possible to operate with both a mill and its exhauster out of service. At small outputs with both mills it is usual practice to run with no secondary air.

Discussion of Results

In Fig. 5 the efficiencies and all the losses are shown in curve form. The gross efficiency curve is built up from the curves of losses so as to give it the proper shape. At the same time it fairly represents the points

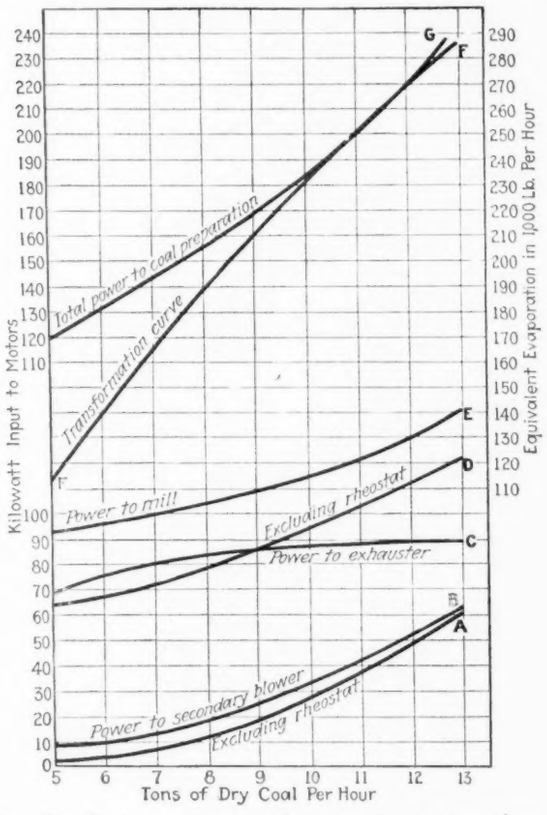

Kilowatt Input to Motors
240 230 220 210 200 190 180 170 160 150 140 130 120 110
100 90 80 70 60 50 40 30 20 10 0
Equivalent Evaporation in 1000 Lb. Per Hour
290 280 270 260 250 240 230 220 210 200 190 180 170 160 150 140 130 120 110
G
F
E
D
C
B
A
Total power to coal preparation
Transformation curve
Power to mill
Excluding rheostat
Power to exhauster
Power to secondary blower
Excluding rheostat
5 6 7 8 9 10 11 12 13
Tons of Dry Coal Per Hour

Fig. 8—Power consumption, coal preparation and burning equipment—Boiler 15 tests

calculated by dividing output by input. It is felt that this method has given a result nearest the truth. The curve for net efficiency comes by calculation from that of gross efficiency. The per cent rating shown on the horizontal scale is based on the water heating surface of the boiler plus the surface of the exposed face of the blocks on the water walls of the furnace. Attention is called to the satisfactory manner in which the effi-

ciency holds up even at the high ratings. No particular attention was paid to the directing of the operators during the tests. The results, therefore, indicate closely what may be expected in day-in and day-out operation.

Power for Milling Varies with Moisture in Coal and Temperature of Primary Air

In Fig. 6 are the temperatures of the flue gases. Considering the fact that the boilers are only eleven tubes high and have no air preheaters, the losses in the dry flue gases are not excessive. In Fig. 7 is shown the relation between the quantities of primary and secondary air. It is to be noted that the quantity of primary air remains nearly constant, falling off only at the lighter loads. Practically all the regulation of air is done on the secondary.

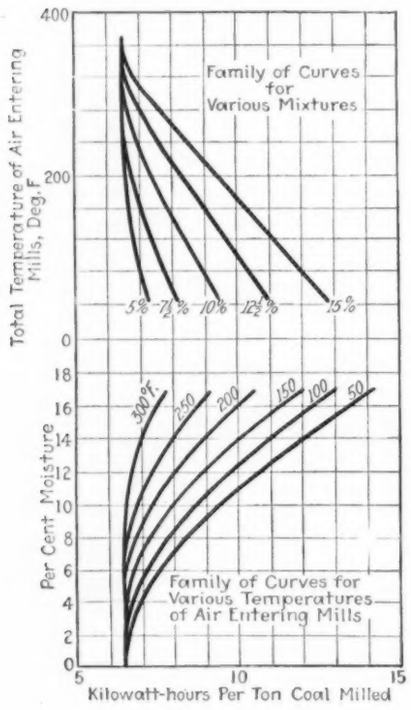


Fig. 9—Effect of variation of moisture in the coal and primary air temperature on the power consumption of the mills—Boiler 15 tests

The power consumption curves shown in Fig. 8 are the result of data obtained on many short tests. Fig. 9 shows the variation of milling power with moisture in the coal as well as temperature of the primary air. The data for these curves result in points which are considerably scattered. For this reason the curves serve only as indications of what is to be expected. Further tests will be required before they may be considered reliable. There is also an indication in the existing data that the kind of coal will have a material effect on the curves. Even with the curves as shown, it is safe to draw the conclusion that the power saved by preheating the primary air cannot pay for the heating. The preheaters should therefore be used only for obtaining required capacity from the mills.

Acknowledgment is made to the Babcock & Wilcox Company and the Fuller-Lehigh Company, represented on the work, respectively, by Messrs. G. A. Shoemaker and Rolfe Shellenberger and their assistants, for their valuable help on the tests and in compiling the data.

In conclusion it may be stated that the installation at Buffalo has demonstrated that low-fusion ash coal may be burned in comparatively small furnace volume at high maintained efficiencies and that the direct firing system permits wide flexibility of operation with low cost per ton of coal handled.

What Do You Know?

By L. H. Morrison

The answers are on page 798

FEW of us follow the lead of that famous old Latin stump speaker, Cicero, who said that when he did not know a thing he was not ashamed to confess it. In fact we hesitate about acknowledging to ourselves a lack of information on a subject. Now the ten questions below will permit you to overcome this modesty, for by checking your answers with those given, you will be forced to acknowledge that you do or do not know the correct answers. Anyone should answer at least two, and if one rightly thinks himself good, all his answers should agree with those given by the editor.

Ques. 1—Why cannot a regular duplex steam-driven water pump be used as a dry vacuum pump?

Ques. 2—Is there any marked difference between the per cent CO_2 possible when burning coal and when burning natural gas?

Ques. 3—What furnace temperature would you expect to obtain with natural gas?

Ques. 4—In an absorption refrigerating plant what determines the steam pressure to be carried in the generator coils?

Ques. 5—Why is producer gas not as successful in gas-engine plants as it is in industrial furnaces?

Ques. 6—In a horizontal fire-tube boiler should the manhole in the shell have its long axis extend along or across the shell? Why?

Ques. 7—Are the seams of high-pressure cracking stills in oil refineries welded or riveted?

Ques. 8—Will the length of high-tension transmission line compared to the amount of energy transmitted, have any influence on a generating station's power factor?

Ques. 9—Suppose it is impossible to obtain over 26 in. vacuum in a surface condenser which usually gives 28.5 in. What might be the cause?

Ques. 10—What is the horsepower of a 10-ft. windmill in a 10-mile-per-hour breeze?

Film Evaporation Applied to Return-Tubular Boiler Increases Capacity 75 Per Cent

A MEMBER of the editorial staff of *Power* was recently invited to view further developments and new applications of the LaMont steam generator at the Botany Worsted Mills, Passaic, N. J. The principles of this generator were described in the Nov. 23, 1926, issue.

Since that article was published, test and development work has been conducted by the manufacturer and it has been demonstrated that film evaporation is equally effective in horizontal and vertical tubes, and that this method of steam generation makes possible high rates of evaporation under severe primary heat without damage to the heating surface. The tests have also demonstrated the practicability of high capacity in small space and the possibility of materially increasing the power from existing steam boilers of the fire-tube type.

The test apparatus, which has been in operation over a period of many weeks, consists of the following: One horizontal return-tubular oil-fired boiler operating at 110 lb. pressure, under which is mounted horizontally one tube tray *E* consisting of thirty-five $\frac{5}{8}$-in. O.D. by $\frac{1}{2}$-in. I.D. seamless steel tubes expanded into a header at each end, giving 94.9 sq.ft. of heating surface; one circulating pump *A;* one twin strainer *B* located between the pump and the inlet header; one orifice tube *B* for distributing the water to each tube. Fig. 1 shows diagrammatically the arrangement of this equipment.

It has been unsafe to operate this particular boiler above 150 per cent of rating without the tube tray in place. With the shell of the boiler protected with a tray of tubes as shown, it is found that the rating on the boiler may be increased without danger to the shell with the additional advantage that a large quantity of steam is produced in the tray.

About 7,950 lb. of steam per hour total appears to be a good average operating condition for the combination tray and boiler (exit gas temperature about 490 deg.) compared with the 4,500 lb., which is considered a safe average operating condition for the boiler alone, giving an added steam production of about 75 per cent with no danger of damage to the boiler, tray or brickwork.

Extension of the film to cover and keep wetted the entire surface of the tube is effected by the velocity of the steam and water. This velocity in a single direction is maintained by the positive introduction of water into the tubes under pressure of the circulating pump *A.*

After 1,500 hours of continuous operation with water conditions which would unquestionably cause scale in the ordinary boiler (and which in the case of the boiler shown did cause scale) the tube elements showed no sign of deposits. This non-scaling quality of the small tubes is due to the scouring action of the steam and water under high velocity and the turbulence resulting from violent film ebullition. These factors act to prevent deposition of solid matter.

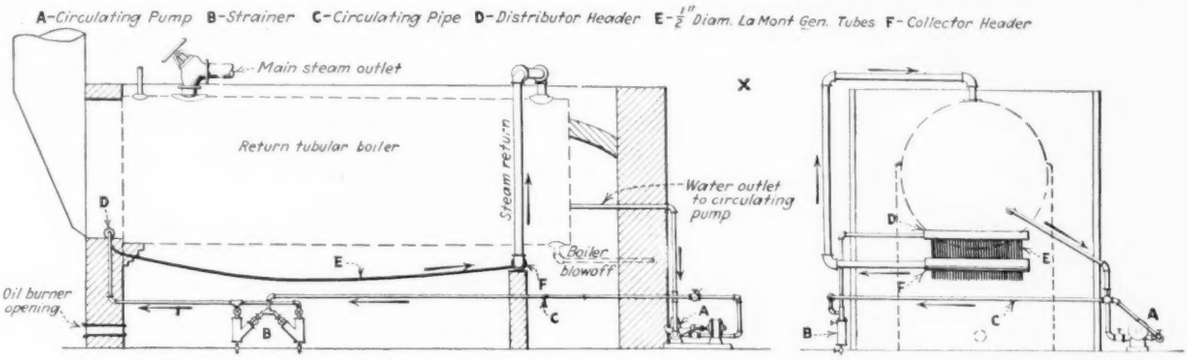


Fig. 1—Arrangement of tube tray below return-tubular boiler and interconnecting piping

Designs are now in process for the application of the horizontal tubes to the Scotch marine boiler as indicated in Fig. 2, and also the locomotive fire-tube boiler. In the case of the Scotch boiler four tube elements can be installed in one $3\frac{1}{4}$-in. I.D. boiler tube, which will give the advantage of increased heating surface without any increase in space, occupied by the boiler.

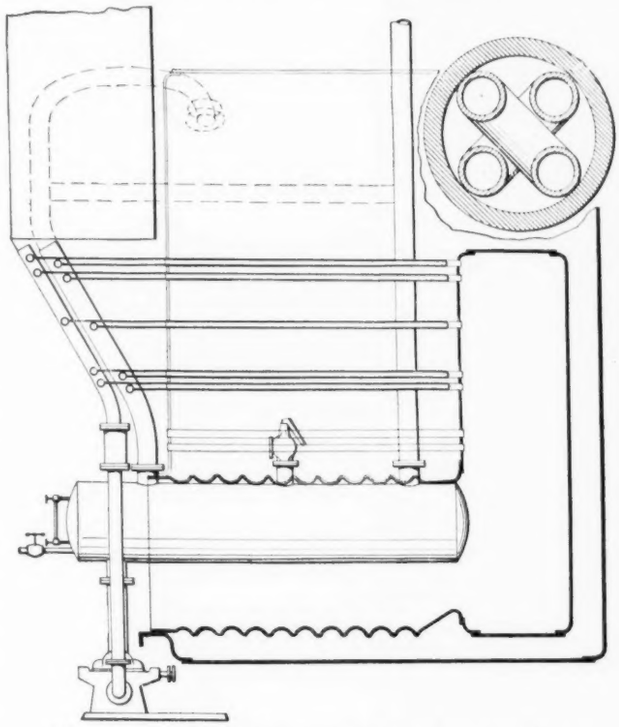
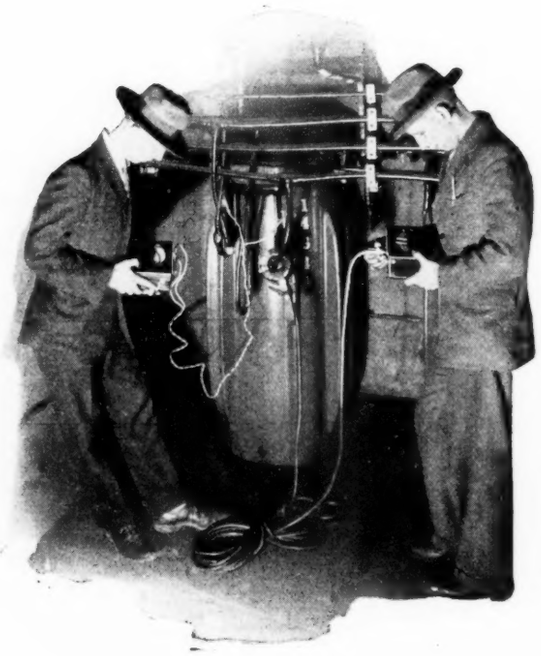


Fig. 2—Small steam generating tubes applied to Scotch marine boiler

ELECTRICAL *Operation and Maintenance*

Are Your Transformers Overloaded?



MAURICE D. SMITH, *in this article, tells you how to make the necessary tests to check up on the loading of this kind of equipment.*

ELECTRIC light and power companies as well as large industrial plants, which use many transformers, occasionally overlook the importance of periodic transformer load tests. For instance, in a plant much load may be added to the transformers during the summer months. This seldom affects the transformer between April and October. The modern type of industrial plant receives sufficient light in the summer months so that practically no artificial light is required during the working day, and may be particularly noticeable in communities where daylight saving is in effect. However, as soon as this period has ended and an hour is added to the evening the station and transformer peak loads will increase rapidly.

This peak increases daily until a maximum is reached some time in December, at which time, power and lighting loads overlap, thus giving a maximum peak for the year. The period between Oct. 1 and Jan. 1 may therefore be called a danger zone, and during this time various troubles may result from overloaded transformers.

A transformer failure may prove expensive in that it will interrupt power to a factory, forcing many workers to be idle until a new transformer can be installed. If a three-phase closed-delta transformer installation were used, the delay would exist until the two remaining transformers could be reconnected for open-delta operation. Again, the load on a transformer might not be sufficient to burn it out, but high enough to cause low voltage on the secondary.

These troubles can be avoided by a periodic transformer load-testing routine. This routine must be such that, when properly executed, it will reduce to a minimum the interruptions and low-voltage troubles caused by overloads.

The testing equipment necessary is neither expensive nor elaborate. For testing transformers one voltmeter and two equipments for taking current readings are required. One instrument manufacturer constructs a testing outfit consisting of an indicating ammeter and a split-core current transformer with leads. The transformer has three ratios, and there are three corresponding scales on the ammeter. An outfit having 35-, 125- and 250-ampere scales will serve to take readings on single-phase transformers up to 50-kva. capacity. Another outfit having amperage scales of 50, 500 and 1,000 will allow current readings to be taken on single-phase transformers up to 100-kva. rating. The 1,000-ampere equipment should be used on all three-phase power transformer installations of over 45-kva. rating. The starting of a large motor will cause a heavy current inrush and will make the needle on the ammeter swing sharply to the right. If the needle happens to be near the top of the scale when the inrush occurs, it may be damaged by going off the scale. Therefore care must be exercised to have an ammeter of sufficient range to prevent such operation.

The voltmeter should be a two-scale instrument having either a 150- and 300-volt or 300- and 600-volt scale range, according to whether the secondary voltage is 110 and 220 or 220 and 440 volts. Leads of two conductor twisted No. 14 wire with a durable braid covering will prove satisfactory. These leads should be long enough to permit an observer to take voltage readings on the ground if a transformer is located on a pole. To one end of the leads should be connected sharp metal

ELECTRICAL *Operation and Maintenance*

points so that the points may be forced through the wire insulation to make contact with the wire. This method will prove more satisfactory than untaping the joints or cutting away part of the insulation for taking voltage readings.

To facilitate locating the transformer and recording the readings taken, an envelope about 4x6 in. of heavy paper with information similar to that shown in Fig. 1, printed on the front, will prove convenient. In the

PERIODIC TRANSFORMER TEST REQUEST

Transformer Number ..... Size Kva.....

Location.....

Nature of Load .....

Tester's Name ..... Date of Test.....

Requested By..... Date Requested.....

Fig. 1—Transformer record card

envelope should be included a card 3x5 in. with the data shown in Fig. 2. The form on the envelope should be filled out in the office from records and issued to the tester, who will carry it with him to the transformers to be tested. The card shown in Fig. 2 is to be filled out by the tester when taking readings. The letters *R*, *N* and *F* in the vertical column under "Field" mean road, neutral and field, and indicate that readings taken on the road wire are to be recorded opposite *R* and so on. Under

TRANSFORMER TEST DATA

Transformer Number ..... _____ Kva.

Amperes..... Volts.....

Field	Room		
R	L	_____	_____
N	N	_____	_____
F	R	_____	_____

Time _____ A.M. _____ P.M.

Fig. 2—Transformer test-record card

column "Room" the letters *L*, *N* and *R* mean left, neutral and right. This column is for readings taken on the transformer leads from left to right, when the transformer is located in a room. Data asked for on the card not taken in the field may be crossed out, thus indicating whether the transformer is located on a pole or in a room. These cards may be modified to suit any particular conditions.

Upon completion of the tests these envelopes and cards are returned to the person issuing them. This person calculates the various transformer loads in kilovolt-amperes and decides from the results obtained what course of procedure will be followed in disposing of the conditions found.

On a single-phase transformer the readings are taken at the points indicated in Fig. 3. Test data on power transformers can be taken during the working day and should be taken when there is at least an average load. Test requests are issued the same as for lighting transformers, with the exception that a card is made out for each transformer in the power installation and all cards in that group clipped together. Test data for each transformer are noted on its respective card and the group of cards returned together. From these data the transformer loads are calculated. Voltage and current read-

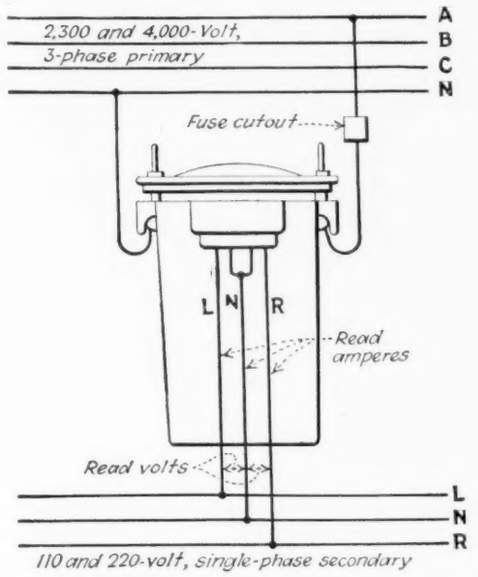


Fig. 3—Indicates where ampere and voltage readings are taken on single-phase transformer

ings on a three-phase bank of transformers are taken at the points indicated in Fig. 4.

Suppose the current and voltage readings obtained on a 25-kva. transformer were:

$R = 170$ amperes and $L = 155$ amperes
R to $N = 111$ volts and F to $N = 110$ volts
$Kva. = 170 \times 111 = 18.9$
$Kva. = 155 \times 110 = 17.1$

Total *kva.* $= 36.0$

This indicates that the transformer is overloaded $\frac{(36-25) \times 100}{25} = 44$ per cent.

This shows a dangerous condition to exist and one that may cause the transformer to burn out, blow the primary fuse or cause low-voltage complaints. In this case action should be taken immediately either to replace the transformer with a larger one or to install an additional transformer and cut load over to it from the heavily loaded unit.

ELECTRICAL *Operation and Maintenance*

Periodic transformer tests frequently show a heavily unbalanced secondary. Suppose on a 37½-kva. 110- and 220-volt transformer readings were obtained which showed $R = 160$, $N = 100$, $F = 60$ amperes, and readings taken from $R - N = 108$ and $F - N = 114$ volts. The results show the load carried to be within safe limits, as each winding will carry $37{,}500 \div 220 = 170$ amperes at full load. But there exists a heavy neutral current which will tend to unbalance the voltages and possibly cause a low-voltage complaint. Indicating ammeter readings taken on the secondary system and services with the split core transformer and ammeter set will indicate where the unbalance exists. Action may then be taken to rearrange the secondary load to obtain a balance on the transformer.

It may be found that a secondary system is so unbalanced that one coil of the transformer will be heavily

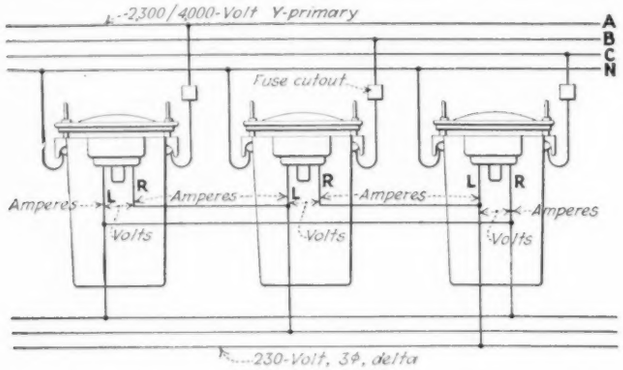


Fig. 4—Where voltage and current readings are taken on a three-phase bank of transformers

overloaded and the other coil carrying a light load, and still the sum of these loads will not show the transformer to be overloaded. This condition is almost as serious as having both coils overloaded, since the heavily overloaded coil may burn out and thus cause a service interruption. The secondary windings should be kept as nearly balanced as possible so as to prevent unnecessary losses and interruptions.

Assume that the readings taken on a closed-delta power installation of three 25-kva. transformers were as follows:

Transformer No. 1		Transformer No. 2		Transformer No. 3	
	Amperes		Amperes		Amperes
R =	110	R =	110	R =	110
N =	0	N =	0	N =	0
L =	110	L =	110	L =	110
	Volts		Volts		Volts
R to L =	220	R to L =	220	R to L =	220

The individual transformer loads are calculated in the same manner as for one transformer; that is, the load is $110 \times 220 = 24.2$ kva. per transformer.

It has been found where abnormal readings have been obtained, that conditions which eventually would have caused a complaint or service interruption could be located and repaired, thus averting an ultimate source of trouble. In conclusion it might be said that the purpose of a periodic transformer-load test routine is manifold and well worth consideration for preventing expensive losses of equipment, interruptions, complaints and excessive or undesirable secondary losses.

Wrong Coil-Lead Pitch Caused High Motor Speed

By George Richter

SOME TIME ago I was called by an armature winder to test a direct-current armature. This armature was from a 20-hp. 110-volt adjustable-speed motor, which had a speed range of from 400 to 1,200 r.p.m. After the armature was rewound, the slowest speed that the motor would operate at was about 1,200 r.p.m., and weakening the field caused the machine to operate at an excessive speed, which in one case broke the banding wires.

After making a bar-to-bar test of the armature winding and finding no defects, it was decided that the winding was not properly connected. The coils were grouped to form a series winding, and as the speed was about three times normal, it was suspected that a mistake had been made in the coil-lead pitch on the commutator that resulted in a three-parallel series connection, when the original winding was a single-series.

The machine had four poles and there were 60 slots in the armature, with 3 coils per slot: One coil was left dead in the winding, making a total of $(60 \times 3) - 1 = 179$ active coils. In the commutator there were 179 bars. The coil lead pitch on the commutator, for a single-series winding, is determined by the formula, $Y = \frac{N \pm 1}{P}$, when Y is the number of commutation segments included between a coil's leads, N the number of coils in the winding, and P the number of pairs of poles.

In this problem the machine has 179 coils in the armature and two pairs of poles. Then $Y = \frac{179 \pm 1}{2} = 89$ or 90 segments. For a three-parallel series winding, $Y = \frac{N \pm 3}{P} = \frac{179 \pm 3}{2} = 88$ or 91 segments.

Since the armature was completely wound, it was not possible to check up the coil pitch without unsoldering some of the coil leads. To do this with a minimum amount of work, two points were selected on the commutator 89 segments apart, which was the approximate pitch of the coil leads. At each of these points three of the top leads were lifted, then by testing with a lamp from the coil leads at one point to the segments at the other, the leads of one coil were found and then the segments between these leads were counted.

The check showed that the leads connected to segments 1 and 89, or 88 segments between the leads. This indicated that a mistake had been made in connecting up the winding, which resulted in a three-parallel connection when the coils were originally connected in a single-series winding. This mistake was made by the winder assuming that a count of 1 to 89 included 89 segments, when this count represents only 88. The leads include only one-half of each segment they connect to. Therefore, to include 89 segments, the coil leads must connect to segments 1 and 90. This was done and the machine, when reassembled, went into service without further trouble.

REFRIGERATION *for the Engineer*

The Engineer Explains

Fulton Ice Plant's Efficiency

By J. R. Bernd

THERE appeared in the Nov. 15 issue of *Power* an article describing the plant of the Fulton Ice Company, New York City, and some results attained, that probably may elicit the scepticism or incredulity of persons acquainted with ice-plant performance.

As I am the chief engineer of this plant and we can substantiate any statement I make, with accurate records of facts, I purpose outlining briefly the methods used in operating the plant.

One of the things that deserves more attention in the field of ice making is the two-stage compressor with clearance pockets. In the first place, let me say that I do not believe that we can take out a single-stage compressor and replace it with a two-stage unit of the same piston displacement and increase the ice output 10 per cent or reduce the power cost per ton. I do claim that with the proper clearance pockets the ice output can be reduced 35 per cent while maintaining the same power cost per ton. As long as the compressor must be large enough to make capacity with the warmest ammonia and the warmest water, and as these conditions prevail only 10 to 40 per cent of a year, a single-stage compressor without clearance pockets must operate with increased power cost per ton, from nine to ten months of the year when the ice demand is low.

Any man with common sense can comprehend that an ice plant should use less power and make ice with less power cost in winter than it does in summer. But why does it not do so? Because the owner had capacity in mind only when building the plant, and the ice-machine manufacturer knows it costs more money to design and build a plant that is flexible and can be operated to get the benefit of the lower temperature in winter; so he will put in his bid to make capacity with the highest ammonia and water temperatures and ignore the compressor power.

A two-stage clearance-pocket plant must be designed for two-stage operation and must be operated as a two-stage plant. The operating engineer must be able to predetermine the brine temperature, the coil temperature, the suction pressure and the temperature difference required to freeze a can of ice in a given time. When this temperature difference is once established, it will hold good up to 28 deg. F. brine.

The ice output will vary in the same ratio that the temperature of the ammonia and water does, as do also the power and cost per ton ice. But it would require 30 per cent more ammonia in the system to operate at a 2-deg. difference than would be required at an 8-deg. difference.

Of course I am taking for granted that all cans are kept in service. At the Fulton plant we can make 200 tons of ice in 24 hours at 41 kw.-hr. per ton, down to 50 tons in 24 hours at 38 kw.-hr. When we attempt to go over 200 tons per day or under 50 tons, our power cost per ton increases out of all proportion; in July or August we make 205 tons at 46 kw.-hr. per ton. Making 30 tons per day, we use 56 kw.-hr. per ton in winter with can water at 35 deg. F.

The auxiliaries are designed for three quantities of production. There are three pumps for circulating water and three air compressors, but we operate only two of the air compressors when making 200 tons of ice and one air compressor when we go lower than 125 tons.

Most operating engineers cut out one or more ice tanks in winter to keep from operating air compressors for all

REFRIGERATION *for the Engineer*

FULTON ICE CO.

TANK LOG — Date Sunday Oct 9- 1927

	TIME	TANK No. 1 STARTED Row No.	TANK No. 1 STARTED Can No.	TANK No. 1 STOPPED Row No.	TANK No. 1 STOPPED Can No.	TANK No. 2 STARTED Row No.	TANK No. 2 STARTED Can No.	TANK No. 2 STOPPED Row No.	TANK No. 2 STOPPED Can No.	No. Cakes Pulled
HEYER	12 MN.	17	1	27	18	17	1	27	18	216
Harleston	8 A. M.	29	1	10	18	29	1	10	18	216
HEYER	4 P. M.	12	1	22	18	12	1	22	18	216

	TIME	TANK No. 3 STARTED Row No.	TANK No. 3 STARTED Can No.	TANK No. 3 STOPPED Row No.	TANK No. 3 STOPPED Can No.	TANK No. 4 STARTED Row No.	TANK No. 4 STARTED Can No.	TANK No. 4 STOPPED Row No.	TANK No. 4 STOPPED Can No.	
HEYER	12 MN.	17	1	27	18	17	1	27	18	216
Harleston	8 A. M.	29	1	10	18	29	1	10	18	216
HEYER	4 P. M.	12	1	22	18	12	1	22	18	216

TOTAL CAKES 1296

CAKES ON HAND

TOTAL CAKES

Chief Engineer

Fig. 1—Log of tank output

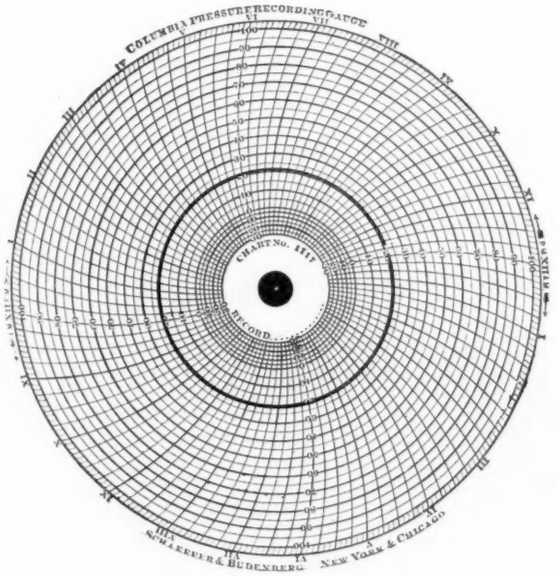


Fig. 2—The suction pressure is uniform during the entire day

the cans, and there is where they kill the goose that lays the golden egg. We have found at the Fulton plant that it requires 19 lb. of air pressure at the can, with 30 lb. at the dehydrator, to make a clear block of ice with 12-deg. brine. This ice does not crack provided we take it out of the tank when finished.

In Figs. 2 and 3 are given the ranges of temperature and pressure that we employ to produce 199.8 tons of ice a day for a period of 28 days during August. Operating engineers should be able, by comparing these temperatures and quantities with the temperatures that prevail in their plants, to see readily if there is anything in two-stage compression with clearance pockets.

When making 199.8 tons of ice a day, we have 500 gal. of water at 55 deg. going over the condenser; there is a 50-deg. coil temperature with a 19½-lb. suction, which makes 8 deg. of temperature difference. The suction temperature is 25 deg. at the machine, the low-pressure discharge is at 80 lb. with a temperature of 157 deg., the high-pressure suction is 88 deg. and the high-pressure discharge is 180 deg. with a pressure of 135 lb. gage. The ammonia leaving the condenser is at 78 deg. F., and at the expansion valve it is 18 deg. F. The can water has a temperature of 70 deg. F. continuously for 28 days without a change worth mentioning.

The plant must be equipped with proper accessories to permit observation of the operation without feeling or

DAILY PLANT LOG — FULTON ICE CO. TEMPERATURES FAH. — Date Sunday Oct 9- 1927

	TIME	MACHINES OPERATED HRS. PER DAY No. 1	No. 2	No. 3	No. 4	PRESSURES AMMONIA HIGH PRES.	ITHD. PRES.	LOW PRES.	HIGH SUC. PRES.	AERATING SYSTEM	AMMONIA HIGH PRES.	ITHD. DCHG.	ITHD. SUC.	TANK SUCTION	HIGH SUCTION	LIQUID FROM COND.	FROM LIQ. COLS.	WELL WATER FROM WELL	OFF AMM COND.	OFF LIQ. COLS.	VENTURI	TO CANS	OUTSIDE ATMOSPHERE	FREEZING TANKS No. 1	No. 2	No. 3	No. 4	ICE STOR.	QUANTITIES KILLOWATTS DAILY MIN. GPM	WATER LOAD IN RECIR.	ICE PLT. CRS.	DEMAND	CONSUMED
HEYER	12 N	4	4			138	76	21		30-18	176	134	90	24		75	61	55	68	Low 18 High 30	149	40	69	13.5	13	13	13	31	535	4	216	300	2102
Harleston	8 A. M.	4	4			138	76	21		30-18	176	156	90	24		75	61	55	68	12 30	149	40	69	13.5	13	13	13	31	535	4	216	300	
"	12 N	4	4			138	76	21		30-18	176	155	90	25		75	61	55	68	12 30	149	42	65	13.5	13	13.5	13	31	535	4	216	300	
"	4 P. M.	4	4			138	76	21		30-18	176	155	90	22		75	57	55	68	14 23	149	42	65	13	13	13	13	30	535	4	216	300	
"	8 P. M.	4	4			138	76	21		30-18	176	156	90	23		75	57	55	68	14 23	149	42	65	13	13	13	13	30	535	4	216	300	
"	12 M.	4	4			138	76	21		30-18	176	154	89	24		75	61	55	68	14 27	149	40	68	13.5	13.5	13	13	29	535	4	216	300	
HEYER	4 P. M.	4	4			138	76	21		30-18	176	153	89	23		75	60	55	68	13 27	149	40	66	13.5	14	13.5	13.5	29	535	3.5	216	300	
"	12 M.	4	4			138	76	21		30-18	176	152	89	21		75	57	55	68	15 27	149	42	66	13.5	14	13.5	13.5	29	535	3.7	216	300	2179
		24	24			138	76	21		30-18	176	154.5	89.5	23.3		75	57.5	55	68	13.5	149	41	66	13.4	13.9	13.5	13.5	29.5	535	3.7	216	300	

ICE IN VAULT M. N. 13.3 753

PULLED TODAY 1296 TOTAL CAKES 1296 7700

TOTAL 2049 TOTAL TONS 199.9

ICE IN VAULT M. N. 1755 K. W. PER TON 39.6

" FROM " TODAY 294

SIGNED Chief Engineer

Fig. 3—Temperature and pressure log

REFRIGERATION *for the Engineer*

guessing. The majority of ice plants can fall off in capacity for an hour or more without the change being noticed. In trying to make up the loss, the power consumption is increased out of all proportion—more so if the plant pays for its power on demand. At the Fulton plant during the 28-day period mentioned, the variation in demand and consumption was not over 2.2 per cent.

There are numerous other conditions brought about by two-stage operation that cannot be dealt with here, but there are some things that are so outstanding and so simple that I cannot forego mentioning them. In the first place, one can always visualize, by the temperature coil temperature of +5 deg. F. or less, taken at the suction leaving tanks, we can maintain a suction temperature of 25 deg. F. at machine. When we get over 20 deg. superheat at the suction of the machine, the condenser pressure will begin to rise.

The idea that oil forms a film on the inside of the pipe in the freezing tank is all wrong. Even an oil without a cold test will not stay in the coil if the coil is given enough ammonia to spill over into a trap. The idea that a continuous liquid header is full of liquid, is incorrect.

A liquid header will trap oil until the oil reaches the largest coil opening. The oil will then fill the lowest pipe

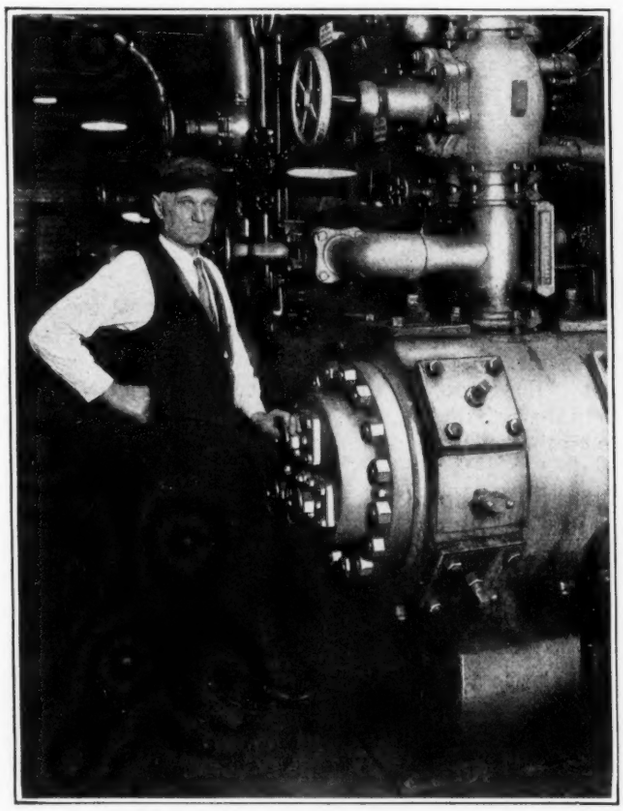


Fig. 4—Operating a clearance pocket

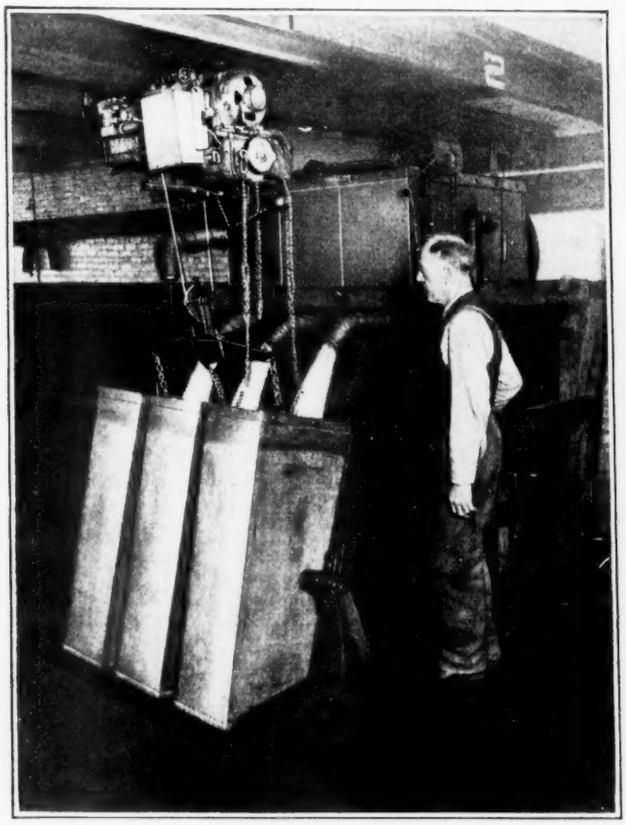


Fig. 5—Cans are pulled and filled in gangs of three

and pressure ranges of the cylinders, the condition of the valves and pistons. It relieves him of the lubrication bugbear, for I believe all piston and valve troubles are caused from insufficient lubrication. At the Fulton plant we give the stuffing box and cylinders 3 gal. of oil in 24 hours. We can do that because the temperature and pressures are split and the oil does not vaporize and pass into the condenser. It enables us to reclaim it to the extent that we use less than one pound of it a year. In fact, the chemist reported that, after use, the oil was in better condition than it was when new. The machines have been in service five years and have received no repairs and adjustments of bearings, this being brought about by the low pressures on the pistons and valves. The highest pressure difference on a piston in terms of pounds per square inch is 55 lb. When operating at a

of that coil until circulation in that coil ceases, and then fill the next highest pipe of another coil. That will continue until enough coils become logy to destroy the pressure balance and force the circulation in the logy coils.

Engineers also notice that by pumping down every few days the tanks work better, because when pumping out, the temperature difference is increased, thereby increasing the amount of gas in the coil and increasing circulation which carries the oil out with it.

At the Fulton plant that cannot happen, as these coils are connected in groups of five coils to the group, each five coils having an independent suction header with its stop valve. By closing the valve, the logy group can be forced through, but if the tanks receive liquid until they spill over, the coils will be kept clean; this spillover lends itself to two-stage compression.

INTERNAL COMBUSTION ENGINES

How Lubricating Oil Can Retain Its Youth

By B. C. OLDHAM

IT MATTERS but little how well an oil engine is built or how perfect the design, if it is not correctly lubricated it will not give satisfactory service. Overall economy in the operation of such engines is not always favorably affected by the price of oil or the amount used, in direct proportion to the price or amount.

THE use of old and broken-down oil is expensive without a doubt, but what appears to be perfectly good oil to some engineers appears absolutely worthless to others. One declares that he would not take a chance on its use, while the other argues as emphatically that he has been using it without any detriment to his engine. The latter may find his methods to be apparently very economical for six months or a year, only to prove the most expensive at the end of two or three years. Damage may occur which can never be undone until the engine is reconditioned and the methods improved so that recurrence is not possible.

THE THREE MAJOR PROBLEMS

At least three major problems are involved in the lubrication of these engines. One is the method employed, another is the selection of a suitable grade of oil, and the third is the manner in which the oil is handled.

At the start it should be properly stored to prevent contamination prior to its being placed in service. This eliminates all makeshifts in the form of tanks and vessels through which it may pass. Subsequent contamination as the result of its being in service is another matter, seldom the same in any two different types of engine.

There are four general classes of engines as regards the problem of oil purification and reclamation. They are as follows: Crosshead-type engines with the crankcase completely separated from the cylinder lower end; trunk-piston engines with the open cylinder lower end in direct communication with the crankcase; two-stroke-cycle engines with crankcase scavenging and engines with separate scavenging pumps. Engines of the oil-cooled piston type influence this problem somewhat, and the two-stroke-cycle engines may be subdivided into the trunk piston and crosshead types.

Of less importance are the different methods of applying the oil, these being cylinder lubrication with mechanical multiple lubricators, cylinder lubrication by the splash system, bearings lubricated with the drip system, and bearings lubricated with the pressure system.

Consider first the crosshead type of engine in which the cylinders are lubricated with clean fresh oil at a rate of about one gallon per 1,200 hp.-hr. in the four-stroke-cycle type and somewhat more in those of the two-stroke-cycle type. This consumption rate is so low that it does not pay to attempt to catch the drippings from the cylinders, for the amount that is actually burned up on the cylinder walls plus the amount that evaporates off the hot walls above and below the piston leaves practically nothing to reclaim. What is left is so badly contaminated with carbon that it is not worth the effort of cleaning. We must charge all the oil fed to the cylinders to daily lubricating oil consumption.

LUBRICATION WITHIN THE CRANKCASE

Within the crankcase, which is separate from the cylinders the working parts may be lubricated by the pressure or drip systems, neither of which will have any influence on the amount of contamination. This oil will not become discolored rapidly, and for a long time it may show but little effect of wear. Final breakdown and contamination of the oil will be the result of water finding its way to the crankcase through leakage of the piston-cooling pipes or some other source, such as condensation or drainage of leaks on the outside of the engine to the inside. Foreign substances finding their way to the crankpits while suspended in the air that pulsates at the breathers, mill scale, rust or foundry sand that may have been left in the pipes and other metal parts, small particles of metal that separate from the wearing surfaces and oxidation as the result of rapid agitation of the oil, are further sources of contamination. A certain amount of dirt may be carried into the crankpits when the engineers enter to work on the bearings.

Every foreign substance mentioned is well removed from the oil in physical characteristics as well as specific gravity, and for this reason a centrifuge will remove it in a satisfactory manner.

Occasional batch cleaning is advisable, at which time

INTERNAL COMBUSTION *Engines*

all the oil should be removed from the system and purified. At the same time the bottom of the crankpits and sump tank should be wiped clean of all sediment. Generally, the upper parts of the pits will need no cleaning since the oil is in itself an excellent cleansing agent.

The centrifuge is not absolutely essential to this type of plant. A well-constructed heating and settling system

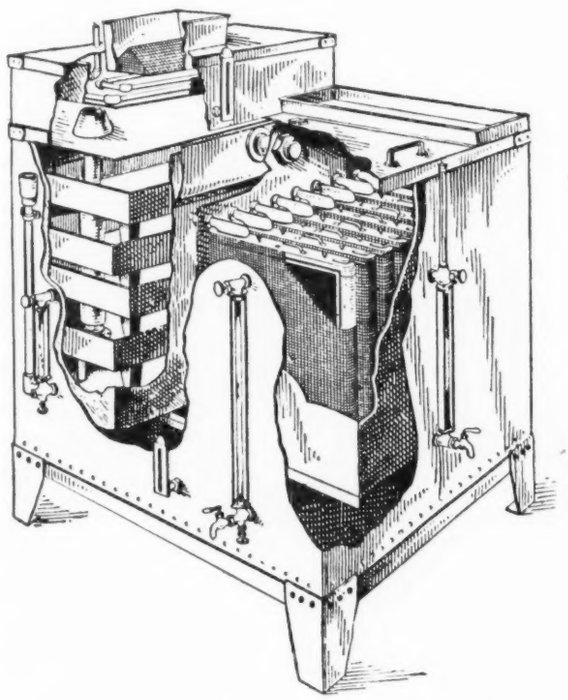


Fig. 1—A typical cloth bag gravity filter

employed in connection with a filter of the cloth-bag type, such as shown in Fig. 1, will serve equally well. Such an arrangement will not be so convenient or rapid, and since engines of this type are large, a large system is required, which will be more expensive than a centrifuge of equal or greater capacity.

Trunk-Piston Engine Lubrication

The trunk-piston type of engine, in which the drippage from the cylinder walls finds its way to the crankpits to mix with the oil used on the bearings, presents an altogether different problem. In this engine we are not so situated that we can choose an oil that is ideally suited to cylinder lubrication unless it is also a good bearing oil, whereas on the crosshead-type one grade of oil may be used on the cylinders and another on the bearings, if such an arrangement is necessary. Part of the carbon picked up by the bearing oil in these engines is so fine that it goes into suspension readily and practically as freely as will pigment. It is of almost the same specific gravity as the oil, and when passed through the centrifuge without first treating it to increase its weight, the carbon does not completely separate from the oil, causing the latter to remain discolored.

In addition to the carbon mixture the oil in the crankpits is subject to all the other forms of contamination mentioned in connection with engines of the crosshead type. The centrifuge will remove all this plus a high percentage of the carbon.

The carbon that remains in oil processed in this way is not abrasive to any appreciable extent if at all, and does not appear to cause any more rapid wear of the bearings. Carbon of this kind causes trouble only when it exists in such high percentage as to thicken the oil and prevent its proper distribution through failing to spread, if actually delivered to the bearings or failing to flow through the drip feeds in a system in which drips are employed.

Carbon Troubles Should Be Guarded Against

Carbon should not be allowed to accumulate to such an extent as to cause troubles of this sort. Under unfavorable conditions of operation carbon may enter the system more rapidly than it can be removed, and when this occurs, the problem of cleaning the oil passes out of the realm of centrifuges, filters, settling tanks and sludging systems and enters that of combustion and load control in the cylinders. When combustion is very foul, the operator generally increases the flow of oil to prevent the pistons from dragging, and this oil acts as a flushing agent, carrying the excess of carbon, soot and partly burned fuel into the crankpits until the excess of oil on the cylinders causes the piston rings to stick, after which the engine will not run. In the meantime the crankpits

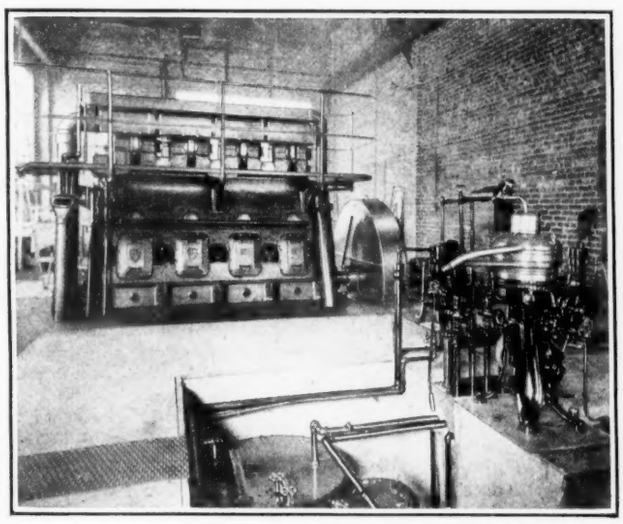


Fig. 2—A centrifuge in an oil pipe-line station

may become fouled beyond the capacity of any filtering system.

Fortunately, this is not a common condition, and we generally find the crankpits of engines of the trunk-piston type to be as clean as those of the crosshead type.

To throw the oil away when removed from crankcases would be a waste in no way justified, since it may be reclaimed with entire satisfaction. Two methods may be employed. One is what is known as the settling sys-

INTERNAL COMBUSTION *Engines*

tem, in which the oil is transferred to tanks or vats having some means of heating the oil. The temperature will be raised slowly to about 180 deg. F., at which point the oil will start to bubble and foam on the surface. After holding this temperature for several hours, the oil should be let cool slowly and then stand for ten or twelve days at a temperature of not less than 75 deg. F. The top will be clarified, and the bottom will contain the sediment and carbon.

The clear oil may be carefully drawn off and strained

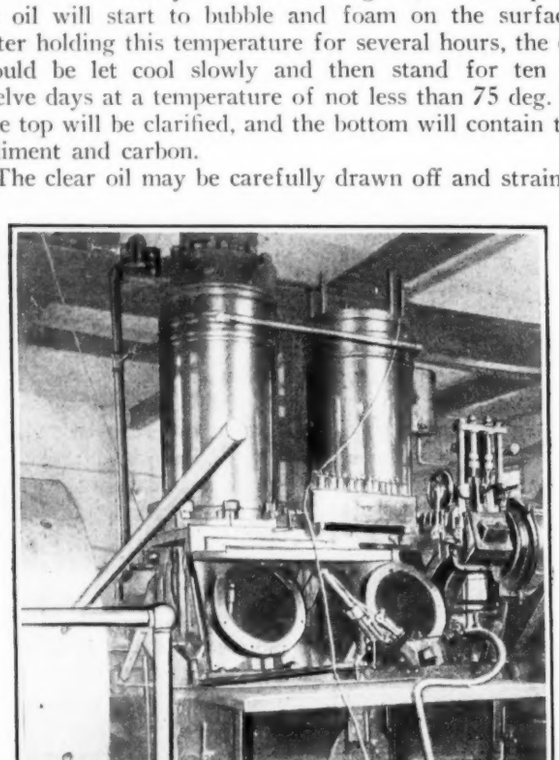


Fig. 3—Cleaning a crankcase with a hose and kerosene

or passed through a centrifuge, such as shown in Fig. 2, and again put in service. If the lighter substances lying between the clarified oil and the sediment should pass through the strainer, it will discolor the oil but not damage it.

The other system is what is known as the sludging method, by which the carbon is made to absorb water, thus rendering it heavy so the carbon will settle out of the oil. The vat should be filled to about one-third its capacity with clean fresh water and washing powder to the amount of one pound to five gallons of water. The washing powder is not absolutely essential, however and merely makes the process more rapid. The oil should be placed on top of the water to a depth of about three-quarters of the capacity of the vat, and heat should be applied in the manner described, except that when the correct temperature is reached it need be held only an hour, after which slow cooling should follow and the oil should be let settle about twenty-four hours.

Two-thirds of the oil that goes into the batch will rise to the top of the vat well clarified, and the other third will be mixed with the sludge which will settle to the bottom with the water. The process of drawing off the clean oil and straining it will be the same as with the settling system. A heavy oil loss is always sustained when using this system.

A sludging system should be built with a capacity equal to the demand of the plant, making it possible to process all the oil in the lubricating system in one batch. It is well to have the bottoms of the sludging tanks funnel-shaped with a large valve at the lowest point, from which a pipe may be led with gradual bends or long radius fittings to the point at which the sludge is to be dumped. Even then it may be necessary to agitate the sludge with a water hose to make it flow through the piping.

Two Innovations

Two innovations may be added to simplify the process of drawing off the clarified oil. One is a float attached to a swinging pipe in the tank, so arranged that the top end of the pipe will be held by the float just about an inch below the surface of the oil. An arrangement similar to this is sometimes used by the home brewers to prevent the sediment in the bottom of the crock from carrying over into the bottles when the brew is drawn off.

The other arrangement is a pane of glass with a light under it, arranged between the sludging tank and the sump tank of the engine. The oil is let run over this glass in a fairly heavy film, and when the sludge starts to come it will show up in the oil by interfering with the light rays passing through the oil film. Sludging may leave some moisture in the oil, but this will evaporate when it goes into service.

Fuel oil is one of the greatest menaces to lubricating oil, for once they mix they cannot be separated except in an oil refinery. Even a low percentage of fuel oil or kerosene in the lubricants will completely ruin them.

All engines are designed and built with a view to preventing such mixtures but it appears to be a difficult problem since mixtures actually do occur from time to time.

Fortunately, most engines with oil-cooled pistons are of the crosshead type, which eliminates the possibility of carbon contamination of the oil used to cool the pistons. In trunk-piston engines having oil-cooled pistons exceptional care should be taken to keep the oil as free of carbon as possible, since a percentage of carbon that is not great enough to harm the bearings, may be great enough to deposit in the pistons and oil coolers. It will then interfere with the heat exchange in the pistons and coolers and so lower the efficiency of the system as to bring about serious trouble.

It is necessary to do more than clean the oil, because if a batch of processed oil is returned to a dirty engine it will immediately become a batch of dirty oil. The inside of the crankpits should be sprayed with kerosene, and if a hot-water hose is available a good washing will leave them fairly clean. If hot water is not available it will be necessary to wipe down with *rags;* emphasis is placed on the word rags because waste will stick to the surface and foul the system.

INTERNAL COMBUSTION *Engines*

The two-stroke-cycle engine does not present any oiling problems that differ greatly from those of the four-stroke-cycle engine except that where the crankcases are employed as scavenging air pumps there is seldom any attempt made to reclaim any of the oil, a portion of which mixes with the scavenging air and passes on to the working cylinders to be burned up or pass directly to the exhaust ports and out to the atmosphere. Generally, a small drain is left open in the bottom of the crankcase, and the waste oil may be caught at this point and processed if it amounts to enough to justify the labor involved.

Under no condition should this oil be returned to the system without first being passed through a filtration process of some sort, for all the air that the engine uses for combustion passes through the crankcases, and this oil acts as a cleanser, flushing out such impurities as may be carried into and impinged upon the inner surface of the engine. It is a well-known fact that impurities in the air of most engine rooms are sufficient to cause considerable trouble to oil engines unless prevented from reaching the working surfaces. The constant passage of oil serves this purpose, less satisfactorily, but surely as continuously as do air filters.

In every type of engine mentioned thus far cylinder lubrication has been with clean fresh oil. In one type this oil, once used, has been considered as waste, and in another it has been added through drippage to the general supply in the crankcases. Some high-speed engines lubricate the cylinders by means of a splash system. We may consider such oil as a used product, partly worn out, and deteriorated to a certain extent, yet it is used as a cylinder lubricant where the problem of lubrication assumes prodigious proportions. In spite of this, the method works in a highly satisfactory way unless neglect of the oil causes trouble. There is no reason why the inside of such crankcases should not be as clean as any other oil container. The pistons and cylinders are the source of oil contamination, and when clean fresh oil is applied to them, it immediately picks up the same substances that exist in the oil already in the crankcase.

"How Would You Do It"?

ON page 555 of the Oct. 11 issue M. E. Wagner asks for a way to get his Diesel engine unit started, in the absence of starting air. The only objection to starting the Diesel engine with the alternator as a synchronous motor is that the whole plant will have to be down while it is being accomplished.

If the service is intermittent or in a privately owned industrial plant, there will be no one to kick except the owners, but if it is a public utility plant and the service is continuous, it would be quite embarrassing to drop the whole load while starting up an engine.

Not knowing the mechanism of his Diesel or the number of cylinders, it is hard to say whether there is another way to accomplish the task.

If there is means for relieving the cylinders of compression on the compression stroke and shutting off the fuel, it would seem that it would be possible to make a temporary steam connection to the starting air line and turn the engine with steam until the compressor on the Diesel engine could build up the pressure in the air bottles.

Again, it might be possible to use steam in half of the cylinders by shutting off the fuel and blocking the inlet valves open on the remaining cylinders. In this way enough momentum might be obtained to turn the engine against compression for a few revolutions. If the fuel and compression were then applied, these cylinders might carry the engine until under way.

In my opinion, a small auxiliary motor-driven compressor, taking current from the busbars, is necessary to make the plant self-sustaining.

Air under high pressure is hard to hold, and it is usually gone when you need it the most. A gas engine or Diesel plant is not complete unless it has a reliable auxiliary source of supply. Such an auxiliary comes in mighty handy when the emergency arrives, and it is sure to come sooner or later.

EARL PAGETT.

Coffeyville, Kan.

Bids on Oil Engines, City of Saginaw, Mich., Aug. 23, 1927

	Air Injection							Solid Injection		
	Two-Stroke Cycle			Four-Stroke Cycle, Trunk-Piston Type				Trunk Piston Type		
	Cross-head Type		Trunk Piston					Two-Stroke Cycle	Four-Stroke Cycle	
Bidder	1	2	3	4	5	6	7	8	9	10
Rated hp	835	875	875	825	850	825	875	840	835	800
Revolutions per minute	200	225	300	164	212	200	200	257	180	225
No. of cylinders	4	5	6	4	8	8	8	6	5	6
Bore × stroke	17x27	16¾x22	14¾x18	23x32	17x24	17x25	17⅛x24½	16x20	21x30	18x22
Method of cooling pistons	Water	Oil	Oil	Water	None	None	None	Oil	None	None
Mean effective pressure (lb.)	67.5	63.6	62.6	74.9	72.9	72	73.5	53.6	70.7	83.9
Fuel oil burned per sq.in. piston—Area in lb. per hour	0.39	0.34	0.36	0.21	0.19	0.19	0.18	0.32	0.20	2.22
Crankshaft—solid or built up	Solid	Built up	Solid	Solid	Solid	Built up	Solid	Solid	Built up	Solid
Flywheel, weight (lb)	25,000	14,000	18,000	54,000	19,700	35,000	16,900	4,200	44,600	
Approx. shipping weight, one engine (lb.)	193,000	180,000	113,000	327,500	224,250	250,000	227,000	99,000	257,200	130,000
Over-all length	33'-0"	34'-0"	32'-3"	38'-2¾"	43'-2½"	43'-3"	38'-5¾"	31-0¾"	38'-11"	31'-6"
Kilovolt amperes	625	625	625	625	660	625	671	700	625	625
Kilowatts at 0.9 power factor	562.5	562.5	562.5	562.5	592	562.5	604	630	562.5	562.5
Fuel oil, lb. per hr.										
562.5 kw. load	357	375	364	351	337	336	338	387	348.5	336
421.8 kw. load	284	298	288	273	267	255	269	292	263.6	254
281.25 kw. load	216	221	221	206	194	190	199	224	200.7	194
Lubrication oil, quarts per hour										
562.5 kw. load	1.2	0.883	2.3	0.66	0.66	0.66	0.50	1.7	1.12	1.6
421.8 kw. load	1.15	.....	2.2	0.66	0.66	0.66	0.50	1.7	1.12	.....
281.25 kw. load	1.1	.....	2.1	0.66	0.66	0.66	0.50	1.7	1.12	.....
Bid price covering two engines complete with 625 kva. generators and exciters erected on purchaser's foundations	$128,571	$118,00 0	$119,378	$136,000	$120,525	$103,473	*$91,873	$105,000	$114,000	$103,000

*Awarded contract at $73.50 per kva.

EDITORIALS

F. R. LOW, *Editor*

Service Stations of Industry

OWNERS of motor cars, which means almost everybody nowadays, know what a "service station" is. In fact, the accessibility and reputation of a manufacturer's service branches is often the deciding factor in the choice of a car. The automobilist wants to be able to drive into one of these stations and obtain any kind of service he may need—quickly, cheaply and dependably.

On a slightly different basis the power plant can be spoken of as the "service station" of industry. Steam for process and building heating, electric power, compressed air, hydraulic pressure, refrigeration and mechanical power are services by means of which the wheels of production are kept turning. And for all these services the industry depends upon the power plant.

Now, just as good service attracts buyers for automobiles, so will good service attract users for the products of the power plant. That is to say, if the industrial power plant is to continue to supply all these services, it must convince the buyer, which in this case is the production department of the industry, that these services cannot be secured elsewhere more cheaply or with greater reliability. When the production department is so convinced, the future of that power plant is assured. Here is a chance for the power engineer to exercise all his latent sales ability.

Recognition for Industrial Power Plants

"THE most important part of the whole shop," were the words that a well-known production executive recently used in referring to his boiler room. He said that, should it cease to operate, the remainder of the plant would shut down instantly.

This seemed strange, at first, for the factory is located in a large city and central station power should be easily available. Investigation showed, however, that the process of manufacture centered around an assembly conveyor. This conveyor was of the pneumatic type. For good engineering reasons, the compressed air was supplied from steam-driven compressors. Hence the importance of the boiler room to this particular executive.

Such reasons for attention on the part of the management do not exist in every industrial plant, and perhaps that is why so few executives realize the important rôle that the power plant plays in production. There are several ways in which this can be brought to their notice, to the benefit of all concerned. One of the more usual of these is through the accounting department, which often makes the discovery that steam and power costs are not as low as they should be and starts out to find the reason why.

From the point of view of the man in charge of the power plant, that is about the worst way for his plant to come to the management's notice, for he is immediately put on the defensive. To insure against this, he should do three things: First, have his plant in the best possible shape and know what is needed in new equipment to make it better; second, know the exact relation of his plant to the remainder of the factory and how it can give the best and cheapest service; and finally, he must make sure that the management is aware that he knows these things and endeavor to convince them of their importance.

Modernization and Credit

NOTWITHSTANDING the considerable activity in rehabilitation of industrial power plants during the last two or three years, the number susceptible of improvement is still very large. Some managements yet need to be convinced; others, while appreciative of the economies accruing from modernization, are not in a position to make the necessary expenditures. This is especially true of medium-sized and the smaller industrial plants.

The suggestion was made recently in *Power* that attractive possibilities awaited some agency that would finance such improvements, in which case the owner could pay the interest and retire the notes out of the savings, and at the end of a certain period would be in possession of a modern plant without further indebtedness.

The plan, in principle, is not new. It has been applied successfully to a limited extent by individual builders of power equipment, who have their own credit setup, but it has not been applied to the plant as a whole. For such application an independent credit organization must form a part of the picture.

By coincidence, Henry Ittleson, addressing the recent

convention of Association of National Advertisers, stressed the point that insufficient attention has been focused upon the extent to which installment buying may be applied to industrial equipment. "It offers a means," said Mr. Ittleson, "of putting the machine on the payroll and letting it pay for itself by its own productivity."

Power plant equipment, in the broader sense, is just as much a machine of production as one entering into the manufacturing process, and the same reasoning, accordingly, applies.

Credit buying has now become an established factor in our social and industrial structure. When soundly applied, it makes possible vast expansion in sales, as has been demonstrated by the automobile industry. As applied to improved power equipment, it would require some modification in detail, but not in principle.

It is significant that leaders in the credit field are giving thought to the matter. There remains the cooperation of the equipment manufacturer and the response of the customer.

New England's Flood and River Regulation

AS NEW ENGLAND recovers from the effects of the recent disastrous flood, two features of particular interest to power engineers come out of the experience: First the destructive force of unregulated rivers; and second, the fact that this destruction can, to a large degree, be prevented by suitable reservoirs built for flow regulation and power development.

On some of the new England unregulated rivers the flood reached such proportions as to inundate completely the country along their banks, destroy power and industrial plants, and flood others so that they could not operate. On the Deerfield River, which was in the heaviest portion of the deluge, the flood was only normal, none of the seven plants on this river were damaged and all were maintained continually in service during the flood. With an unprecedented rainfall of nine and one-half inches in twenty-four hours the two large reservoirs had sufficient capacity to take care of another equal flood before losing water over their spillways.

It is estimated that if the Deerfield River had not been regulated by storage reservoirs, the flood would have exceeded any previous records by about fifty per cent. This not only would have caused unprecedented damage along this river, but would also have added materially to the destruction along the lower Connecticut.

Those who have opposed or delayed the construction of storage reservoirs might well compare the destruction of property and the loss of human life along the unregulated rivers of New England with the undisturbed conditions on the Deerfield River, and seriously reflect as to which of the two they prefer. The Deerfield River is still a public playground and did not have its service to the community disturbed, where many of the other streams have been the creators of desolation and want. The latter may be preferred to making it possible to control our rivers and for power plants to increase their kilowatt-hour output, but such an attitude is almost beyond comprehension.

So far as the recent flood in New England is concerned, there is nothing to be done about it but to repair the damage where this is possible. The history of river flow shows that, by a certain combination of soil and climatic conditions, more disastrous floods may occur than have previously been experienced. Then, are those responsible for the regulation of rivers going to continue to vacillate and make political footballs out of these problems or are they going to co-operate to the end that the destruction of life and property may be prevented, the natural beauty of the landscape enhanced and the economic value of our water-power resources increased? It is the public's right to expect that the latter will be done.

The Foundation Makes A Difference

THE vibration of machinery is often accentuated by an improper foundation. A foundation that is otherwise excellent may have a natural period of vibration close to the running speed of the machine it supports, and then the slightest unbalance in the machine will set up violent vibrations in the foundation. Any change in the structure that alters its period of vibration may eliminate the difficulty in such a case.

Since it is impossible to balance any rotating machine with perfection, the plant designer must provide proper foundations, especially for the support of high-speed machines. When vibration does develop, the operator should be slow to blame the machine builder until he has investigated thoroughly the characteristics of the foundation as well as of the machine. The difficulty may lie at his own door.

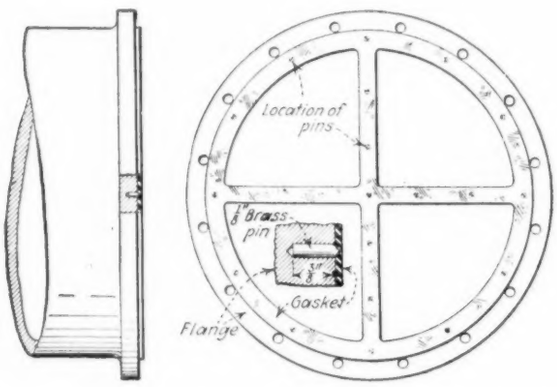
The Locomotive, published by the Hartford Steam Boiler Inspection and Insurance Company, is probably the oldest house organ that was started as such and has been issued continuously. With its issue for the last quarter of this year it celebrates its sixtieth anniversary. In its first number, November, 1867, its chief object was announced to be the discussion of practical questions and more particularly steam power and its applications. It may, therefore, justly claim to be the oldest paper addressed particularly to power users. *Power* doffs its hat to the nestor of its field and wishes it a long continuance of useful service.

IDEAS *from* PRACTICAL MEN

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Method of Fastening Gasket in Narrow Web Between Passes of Small Condensers, Coolers and Heaters

WE HAVE experienced some trouble in holding the gasket in place between passes of heaters because the gasket was so narrow and the head did not fit the tube sheet or waterbox perfectly. When opening heaters, a good many times the gasket is found pushed



Brass wire pins in face of flange holds gasket in place

out in places, causing the water to bypass, cutting down the efficiency of the apparatus.

We have found a way to end the trouble. Drill a series of ⅛-in. holes about ⅜ in. deep into the head along the part separating the passes. Drive pieces of ⅛-in. brass wire into the holes. Cut the wire off with nippers or side cutters just long enough to stick into the gasket but not long enough to go through. The nippers or pliers will leave the wires pointed at the end so that they press into the gasket without any trouble. F. R. RAWSON.

Denver, Colo.

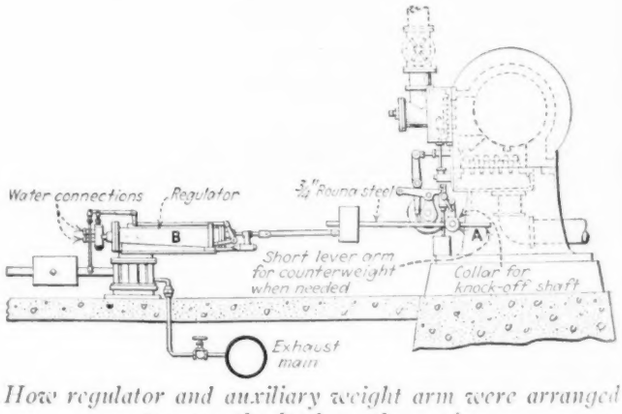
How the Load on the Engine Was Regulated by the Demand for Process Steam

IN THE plant where I am employed there is an 18x42-in. simple engine driving an alternating-current generator that runs in parallel with the local power system. The function of this unit is primarily that of a heat balance, or makeup engine to supply exhaust steam for process work, its load being determined by the demand for exhaust steam over and above what the other engines in the plant can supply.

Formerly, the method of load regulation consisted of throttling the steam supply to the engine, the balanced regulating valve in the steam pipe being operated by an auxiliary hydraulic regulator actuated by the exhaust pressure of 15 lb. gage. When running on light loads with the steam supply nearly shut off, the valves, particularly the exhaust valves, slammed badly owing to the back pressure lifting them from the seats. This action damaged the valves and seats and interfered somewhat with efficient lubrication.

After extensive repairs had been made to the engine, I located the hydraulic regulator previously referred to in a position near the floor at right angles to the knock-off camshaft, as shown in the illustration. On the camshaft and directly in line with the regulator, I placed a collar with a projecting lever of ¾-in. round steel about 18 in. long, or slightly more than the length of travel of the regulator piston. This lever carries a 5-lb. weight, which is free to slide on the bar and which is connected to the regulator by a hinged rod, as shown.

As the back pressure varies, the regulator shifts the weight in or out according to the process steam demand and varies the cutoff and consequently the engine load, by changing the weighting of the governor. The speed,



How regulator and auxiliary weight arm were arranged to vary the load on the engine

of course, is constant, as the unit runs in parallel with a large power system.

This arrangement has a range of about 100 kw. engine load between its extreme outer and inner positions, which takes care of the variations in the steam demand under ordinary operating conditions. To care for extreme conditions, there is another short lever attached to the knockoff shaft, upon which weights may be placed to counteract the effect of the sliding weight.

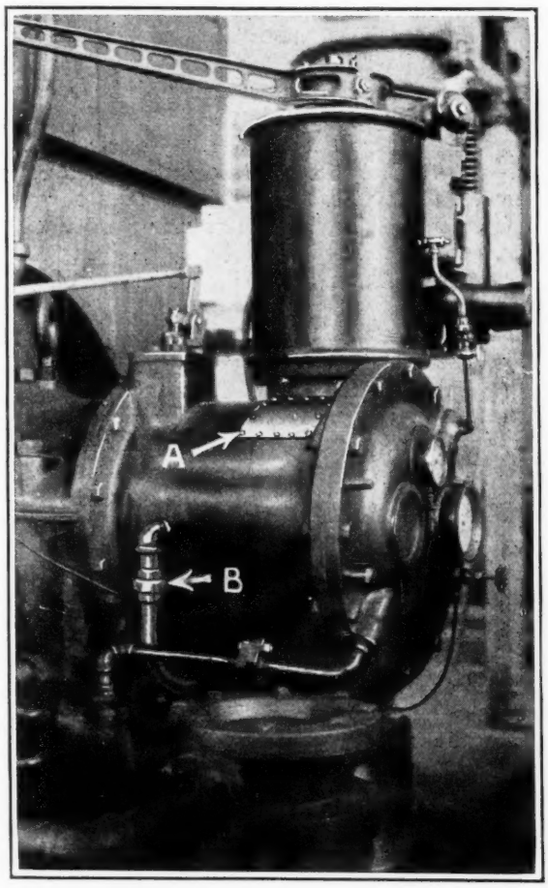
Owing to the floating connection of the weight to the regulator it cannot in any way interfere with the action

of the governor should the generator for any reason break away from the power system. The governor is powerful enough to overcome the weight in its outer position without excessive engine speed.

Fitchburg, Mass. A. M. LEADER.

Improving Assembly of Turbine Governor Drive

IN CERTAIN horizontal turbines built between 1912 and 1918 the governor drive consists of a vertical shaft fitted with a worm gear and a worm attached to the end of the turbine by a flexible coupling, the outboard end of the worm being supported by the bearing cap or end plate. Such a construction constitutes what might be termed a "blind" fit. The adjustment on the vertical shaft and the elevation of the worm and the engagement of the worm and gear is difficult, and numerous assemblies and dismantlings must be made and the machine must be operated awhile to determine if all adjustments are correct. Then the machine has to be dismantled again for inspection.



Handhole in governor gear case facilitates adjustment of worm-gear drive

Such a condition was greatly improved on a 5,000-kw. unit by putting in a handhole as at *A* in the governor gear case near the top and on the left-hand side of the turbine. A series of holes were drilled in the cast iron, and the web of metal between the holes was chiseled out. The size of opening is approximately 3x4 in. Thirteen holes were drilled and tapped for machine screws to hold down a cover made of $\frac{1}{16}$-in. plate. Through this opening we were enabled to observe the effect of changing the height of the vertical shaft and could watch the meshing of the gears as the front plate was put on. By the "feel" of the worm gear we could quickly determine any binding or possible scoring of the front bushing. The turbine could be operated at half speed with the handhole open, and any faulty engagement of the gears could be quickly detected. Furthermore, it was not necessary to wait until something was destroyed or to dismantle the assembly completely every few hours to see the effect of each change.

In the side of the horizontal gear case a $1\frac{1}{4}$-in. pipe *B* has been connected to take the overflow of oil from this case so that the oil will not have to flow through the main bearing case. Greater oil-handling capacity in the worm-gear section is provided and it has been found that a larger quantity of oil bathing the governor gears has kept them cooler and is noticeably prolonging the life of the assembly, which consists of a bronze gear and a steel worm.

J. ELMER HOUSLEY.

Alcoa, Tenn.

Comparative Economies of a Simplex Pump and a Motor-Driven Centrifugal Pump

MAY I call attention to the rather obvious errors in the answer to question No. 10 in the Oct. 18 issue regarding the comparative economies of a simplex steam pump and a motor-driven centrifugal pump for boiler feeding? In the answer given, the steam pump is found to require 150 lb. of steam per hour when feeding the boiler at the average rate of 10,000 lb. per hour. It is then stated that the centrifugal pump will need to operate continuously at the maximum requirement of 15,000 lb. per hour, the excess water being bypassed. It is found that this will require about 4 hp. Since the main unit has a steam rate of 50 lb. per kw-hr. and 4 hp. is approximately 3 kw., the steam chargeable to the motor-driven unit will be 150 lb. per hour and not 200 lb. as stated.

However, there is no need of using a bypass in connection with a centrifugal boiler feed pump. When the demand is less than the maximum, the regulating valve in the feed line at the boiler is simply throttled and the discharge of the pump reduced to the proper amount. The discharge pressure at the pump will rise somewhat, depending upon the characteristics of the pump, and the efficiency will drop off; nevertheless, the power required will be less than if the pump were operating at maximum capacity.

Assume, for example, that the combined motor and pump efficiency of the unit in question dropped from 50 per cent to 45 per cent when the discharge was decreased from 15,000 lb. per hour to 10,000 lb. per hour. Assume also that the discharge pressure at the pump rose 10 per cent. The work then would be 31,630,000 ft.-lb., or 3.5 hp., and the steam chargeable to the centrifugal pump would be approximately 130 lb. per hour, or 20 lb. per hour less than that required by the simplex steam pump.

Newark, Del. P. A. WILLIS.

COMMENTS *from* READERS

Automatic Boiler Blowdown in Proportion to Moisture Content of Steam

IN THE Sept. 13 issue C. E. Joos takes exception to my statement in the Sept. 5 issue that the ordinary type of separator is not so effective as a steam purifier. First, the two devices—that is, separators and purifiers—will require and undoubtedly will receive some definite classification eventually, the situation being akin to that surrounding a definition of the terms "foaming" and "priming." In distinguishing the two devices, I do not hope that my ideas will be adopted in a classification generally, but that my explanation herein will bring about a better understanding.

There is no doubt that a large percentage of the liquids entrained in vapor or gas can be separated therefrom by the action in a baffle-type separator. Because of its success the separator has its position of importance in protecting prime movers from slugs of steam-line condensation, but the fact that such a device has not prevented the passing of finely divided moisture and impurities is quite generally conceded. Engine valves, governors and safety devices have failed and have been eroded badly from boiler-water impurities which certainly passed through such separators.

Perhaps under certain conditions separators will leave no more than ½ per cent of boiler water in steam, but is not this too much? And is not this the reason for steam purification? Let us see.

Suppose a boiler carries a concentration of 300 grains per gallon and the steam is passed through a separator which leaves ½ per cent of boiler water therein. A million pounds of steam then contains 5,000 lb. of boiler water, or about 600 gal. This water carries 180,000 grains of mineral substances at the concentration of 300 grains per gallon. Thus the dirt either dissolved or suspended in the moisture of this amount of steam is over 25 lb. And this weight varies directly with the concentration in the boiler, other factors remaining constant. A million pounds of steam per day of 24 hours may be generated by a small boiler plant of around 12,500 sq.ft. of heating surface. In such a plant, however, in a month the dry weight of the impurities is 750 pounds.

Steam purification in one important sense must begin where the separator invariably leaves off. Since the purifier usually is best placed at the source of the steam inside of the boiler, it also must be designed to do all that the separator would do when the steaming condition is decidedly unfavorable. By utilizing space readily available in many cases inside the boiler, this is being done with a purifier that operates at comparatively low velocities and with a pressure loss less than one inch of water head, which is but slightly more than one-twelfth of the loss referred to by Mr. Joos in his article in the May 10 issue of *Power*.

A striking instance of the difference between purifiers and separators was experienced in a problem of gas purification. Gas at a low pressure leaving a baffle separator similar to that illustrated in the article by Mr. Joos was considered to be free from oil except at times when the operator allowed the oil in the separator to reach too high a level, when slugs of oil were carried along with the gas.

To serve as a safety measure ahead of the compressor, a gas purifier was installed in the line leaving the separator. The purifier in this case really accomplishes two results—it effectively stops oil being carried over when the separator is overloaded, and it removes oil continuously from the gas leaving the separator when the percentage is so low that it had been the practice to consider the gas oil free. The results of this complete oil separation is a marked improvement in compressor performance over that which prevailed when the gas was delivered directly from the separator.

To return again to the article, insufficient data are given therein to make any comments on the figures representing up to 40 per cent moisture by test of trap discharges. As pointed out previously, however, dealing with large moisture percentages is the more or less limited duty of the separator, while the purifier must remove extremely small percentages of moisture. But the purifier is not limited to this duty and may remove large percentages of moisture when they occur. This, however, is a problem of quick drain off rather than one of separation. The device manufactured by the company with which I am connected is not drained off by gravity into a trap, but is drained by force of boiler pressure, as intimated in the article appearing on page 451 of the Sept. 20 issue.

The point is raised of allowing the purifier discharge to serve as the sole method of blowdown, and this can be done in certain cases. In other cases the balance between boiler concentration and moisture content of steam would result in a higher concentration than is considered good practice. In this there would be the chance of greater scaling tendency or greater danger of caustic embrittlement. Thus automatic boiler blowdown actuated by the amount of moisture removed by the purifier applies particularly to these latter cases.

The test of steam delivered from a purifier serves merely to indicate whether the purifier installation is properly made. The presence of impurities in measurable quantities beyond the errors of testing is now the only way of making such a check. Experience over a considerable period during which no deposits occur in steam lines or prime movers, etc., is in the end the only basis for judging purifier efficiency. With separators it is the experience of having these deposits that has brought the demand for the complete removal that lies in steam purification.

W. J. HUGHES,
Chicago, Ill. International Filter Co.

Testing Steel Castings

I ALSO was much interested in the editorial, "Testing Steel Castings," in the June 14 issue.

It is clear from Mr. Morehead's letter of Oct. 25 that he is not in sympathy with the hot-water test for steel castings. He admits that the X-ray method of determining the quality of a casting is too expensive for commercial testing. Such being the case, why discourage the use of a commercially practical test for determining the fitness of a steel casting for service in power plants?

I shall not argue with Mr. Morehead as to whether the hot-water test opens up the metal structure or changes the viscosity of the water so that it will pass through a smaller opening than is the case with cold water. Sufficient to say that the hot-water test has been found to give much more satisfactory results than the cold-water test. The latter test would be sufficient if only the strength of the steel casting were to be determined, but this is not all that is required. In our experience supervising the construction of power plants totaling several million kilowatts capacity, we have never yet had a case where the strength of a casting was involved.

Trouble with steel castings comes from leakage through the metal, which frequently does not show at ordinary room temperatures. However, if the casting is heated, it will often be found that there are signs of porosity in the metal. We had one case where a manufacturer was ready to ship a certain piece of equipment and had reported to our inspector that it had been tested and was ready for his approval. The inspector refused to submit the equipment to test, as the plant was not equipped for a hot-water test. Since the power plant was in need of this equipment, it was finally decided to allow it to be shipped without the hot-water test being applied. However, the manufacturer was informed that he would have to stand the consequences of any troubles which appeared in the field. The manufacturer could have afforded to spend several times the amount of the hot-water test, as he was put to considerable expense when the equipment went into service. He later informed us that the hot-water testing equipment, which he finally put in service, had shown up numerous defects in castings he had purchased from outside foundries.

We have inspected castings at a great number of plants. In fact, we never allow steel valves and fittings to be shipped without having an inspector witness a test, and we have found that no matter how careful the manufacturer may be, there will be times when defective castings will be turned out. Under these conditions we feel that we are justified in asking to have every valve and fitting subjected to the hot-water test. Most manufacturers are at first reluctant to go to the trouble and expense of making ready for this method, but they have generally found that it is to their advantage to do so. In fact, some of them have standardized on this method even when not required by specifications.

Mr. Morehead refers to the fact that not a single casting in the East River Station has proved defective. The same may be said for Hell Gate Station and the other stations which we have built in the last few years, but in every case the hot-water method of testing was used. We know that if this method of testing were not used, we would have considerable trouble with leaky castings.

The ideal method of testing steel castings would be to subject them to the same temperature they would receive in actual service. However, this would mean placing a very large burden on manufacturers owing to the cost of installing such a system.

We insist that a temperature of approximately 250 deg. be obtained. Under this temperature we have found many castings leaky, which, under cold water conditions, were absolutely tight.

JOHN H. LAWRENCE,
Vice-President, Thos. E. Murray, Inc.
New York City.

* * * *

The Decrease in Students in Mechanical Engineering

I HAVE been following with much interest the articles that appear in *Power* from time to time on "The Decrease in Students in Mechanical Engineering." It is interesting to study the viewpoints of different writers. James McIntosh, in the Sept. 20 issue, apparently misunderstands the purpose of a technical training. It is true that "the student comes out of the school equipped with a slide rule, a set of drawing tools and a textbook," but they are his tools and are essential in making the product he has to turn out. A young man does not go to a technical school to be a machinist, patternmaker or toolmaker, although he learns the fundamentals in all of them. He does not care at that time whether a cotter pin will prevent a wreck or whether a cotter pin and a castellated nut go together. His time is precious and he cannot be bothered with minor details which, like Mr. McIntosh's non-essentials, cloud the real issue.

The student's job is to train himself to think clearly and systematically. That in my opinion is the real purpose of a technical training. He must study the theory of engineering just as the captain of a ship studies the theory of navigation. In so doing he develops a system of thinking that better fits him to meet the problems that present themselves in the practical field. The graduate starts in at the bottom as his brother did six or eight years before. He does not expect to guide his brother at this time, nor does his employer expect him to do the guiding. He requires practical training first and realizes this fact. But when a new problem presents itself, the technical man grasps it readily, arrives at the solution and is working on the second problem while his fellow workman is still scratching his head over the first one.

A good employer watches the progress of his men and is always willing to promote those who show ability. The man who surmounts the obstacles gets the vacancy, and as a rule it is the technically trained man. Now the graduate guides his brother and his four years of engineering training have ceased to be a waste of valuable time and money, as some people seem to think. Progress like I have described has been proved by experience.

In order to guide his brother successfully, the technical man must also be a leader. Leadership is a gift to some men at birth, other men can develop leadership, while the majority lack this ability entirely. The enrollment of any university, whether technical or otherwise, is made up largely of the first two classes. This ability may be known to the individual or it may lie dormant. In either case it is developed by university life and study. Military training is one of the greatest developers of leadership and is a compulsory course in most universities. The student is trained, his brother is not. As soon as he acquires the practical side of the line of work he is follow-

ing, he becomes the leader, the foreman and later the executive. The majority of executives in the engineering field today are technically trained men.

The decrease in engineering students, then, is not due to the system of training or lack of it. The real trouble lies in the compensation offered. The entire engineering profession is poorly paid. I have asked a great many men why they did not follow engineering or why they dropped out after a year or two, and almost every time the answer was, "The compensation is not worth the effort." The men who follow engineering as a life work place their interest in the profession, their desire to serve the world, above their desire for material gain.

Chicago, Ill. ROLAND C. LANEY.

MY ATTENTION was attracted by the letter from James McIntosh in the Sept. 20 issue, wherein he sets forth his deductions purporting to explain the decrease in mechanical engineering students. Apparently his idea of a college and a trade school are somewhat confused. For example, he asks whether a college education qualifies the graduate to advise a boy who left school at the ninth grade at the age of 16 and has six or eight years start as a machinist, patternmaker or toolmaker. Any prospective student who enters an engineering college with the idea that he will be taught a trade is certainly badly informed. I have yet to hear of an engineering school claiming to develop proficiency in bricklaying. Assuredly the boy's time is misspent if he goes to college with this in mind.

Engineering, as Mr. McIntosh sees it, should be composed of a thorough education in practically all the skilled mechanical crafts; a good engineer should be an expert patternmaker, molder, machinist, pipefitter, toolmaker, and what not. Apparently the principle of the division of labor has not yet reached him. The old type of craftsman thought the boss should know more about the trades he supervised than did any of his subordinates. Modern business organization could not survive if the plant superintendent or the president of the company had to measure up to old-fashioned standards. Imagine Judge Gary working his way up from second helper on an open-hearth through all the vast composite of steel-mill trades, going through the successive stages of apprentice, journeyman and expert in each, until finally he was deemed fit to become Chairman of the Board because he knew more about the trades under him than did any of his men. Yet Mr. McIntosh apparently believes this.

Moreover, he seems to think that an engineer is a graduate of an engineering school. Nothing could be farther from the truth. It is true that many newly fledged graduates believe this also, but I have found that it takes only about a year out in the industries before they discard that notion. I have an engineering "title" myself, but I have never claimed to be an engineer, nor do I expect to reach that high estate for many years to come. Any so-called engineer who takes his profession seriously understands that his college education was only the beginning of his training and not the end of it, but he is certainly not foolhardy enough to belittle the value of the time he spent in college. I believe no one realizes better than the engineering graduate how little direct application he can make of his college training, and how vast his practical experience must be before he is an engineer in the smallest sense of the word.

Civilization today depends on tools, from the biggest bridge to the smallest twist drill, and tools depend on the ability of seasoned engineers for their design. Mr. McIntosh says, "Lindbergh did not cross the Atlantic as the result of a study based on precedent, but he set a precedent." This is partly true, but so did Charles L. Lawrance, the engineer who gave Lindbergh the tool with which to do the job. That tool was the Whirlwind engine!

Greensburgh, Pa. L. E. HAMMER.

Answers to What Do You Know

The questions are on page 780

Ans. 1—The clearance in the water pump is made large, consequently if it was used to handle air from a condenser the air trapped in the clearance would re-expand on the suction stroke and almost if not entirely fill the pump at a pressure above the condenser pressure. No air would flow into the pump.

Ans. 2—Yes, there is a marked difference with gas from most of the gas fields, the theoretical CO_2 per cent with no excess air is slightly over 11 per cent. In actual firing in a boiler furnace 10.5 per cent is excellent. The CO_2 possible with coal is, of course, higher. The difference depends upon the percentages of carbon in the several fuels.

Ans. 3—With 10 to 20 per cent excess air gas firing gives a furnace temperature of not over 2,000 deg. F.

Ans. 4—Assuming there is no foreign gas present the amount of condenser surface per ton of refrigeration, the amount of cooling water and its temperature determine the steam pressure to be carried. These factors determine the condenser pressure and the steam must have a temperature, and consequently a pressure, sufficient to drive off the ammonia from the strong liquor in the generator at a temperature such that the corresponding saturation pressure is slightly above the condenser pressure.

Ans. 5—The flow of gas to the engine is pulsating and this interferes with the operation of the producer when using soft coal. Likewise the tar and dust are difficult to remove and often gum the valves. On the other hand anthracite coal is too expensive a fuel for producer gas plants in most localities.

Ans. 6—The long axis of the manhole should be crosswise of the shell. This is in order to keep the amount of metal in the lengthwise section as great as possible, as the boiler has a greater unit stress in the longitudinal than in the girth seam or plate.

Ans. 7—A combination of the two methods is used. The seams are first riveted and then the edges, both inside and outside, are welded to prevent leakage. Frequently, the rivet heads also are edge welded.

Ans. 8—Yes. Long high-tension lines act as static condensers and tend to cause the station power factor to be leading, especially at light loads.

Ans. 9—Assuming the circulating pump is delivering the usual amount of water, the loss in vacuum indicates that either there is an air leakage or a lot of the tubes are choked. If it is due to air the temperature of the condensate will be much less than that corresponding to the absolute condenser pressure.

Ans. 10—The horsepower is surprisingly small, being less than $\frac{1}{6}$ horsepower.

New and Improved EQUIPMENT

Miles Automatic Electric Controls

THROUGHOUT the industries and in the power plant generally automatic control is gaining in favor, as in innumerable cases it is becoming established that automatic operation will produce better results than can be obtained by hand. Of the many possible applications mention may be made of combustion control, the regulation of stack and overfire drafts, of air pressures and air-distribution, altitude levels, steam pressure reduction, proportional liquid flow for mixtures, such as the proportioning of alum to water flow in filtration, and of liquid densities. Typical density applications in paper mills are the automatic regulation of the percentage of paper stock in the water going to the forming cylinder vats and the control of the height of the water in these vats.

An automatic electric control that can be adapted to any one of these various uses has been developed recently by the Miles Engineering Company, 1236 Granville Ave., Chicago. The main features of the control system are shown in the accompanying illustrations. Essentially, the control consists of two elements, the power or driving unit and the actuating mechanism. The former remains the same throughout, while the latter is varied to suit the medium under control.

In Fig. 1 the power element is shown to consist of the specially wound inclosed motor that starts and reverses without overloading when operating on ½ ampere of 110 or 220-volt alternating current. The motor is directly connected to an inclosed speed reducer running in oil, which is connected by gear chain and cable to the element being operated

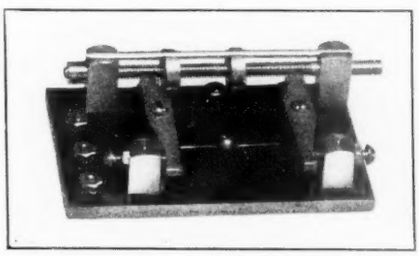


Fig. 2—Type of limiting switch used

for control, such as the uptake damper in a boiler installation. The motor will operate in either direction, reversing quickly from full speed without the use of starting coils, brakes or magnetic switches. The limiting switch shown in Fig. 2 is provided to stop the motion of the motor in either direction at predetermined limits by opening the circuit.

This device is located in the right-hand compartment of the substantial, dust-tight, cast-iron base on which the power unit is mounted. In the central compartment is a plug switch with four sockets that will permit normal automatic operation or the cutting out of the automatic control while operating the motor in either direction to fully open or close the device under control, such as the uptake damper previously referred to. In the left-hand compartment all the terminals of the various elements of the system are assembled, so that any one piece of mechanism may be disconnected readily and removed without disturbing or dismantling the system as a whole.

In the case of boiler damper control, the actuating element is a diaphragm of the construction indicated in Fig. 3, which is connected to the boiler furnace to operate on slight variations in overfire draft. A central stem from this diaphragm rises to one end of a horizontal beam pivoted on knife bearings. On the opposing arm of the beam is a sliding weight to provide for adjustment against the action of the diaphragm, and

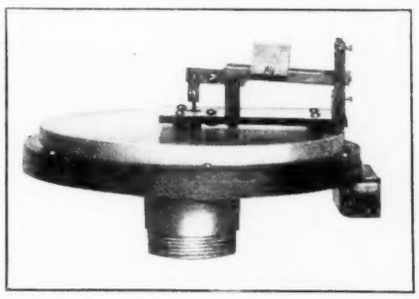


Fig. 3—Diaphragm with automatic switch above

at the end of the arm is a carbon contact which, as the arm moves up or down, comes in contact with carbon terminals secured to an upright column at this point. When the beam swings to the upper terminal, the motor operates in one direction, and in the reverse direction when contact has been made at the lower terminal. This closing of the circuit at either terminal causes the motor to turn in the proper direction to re-establish the predetermined regulation, and when this has been accomplished, the beam swings back to its central, neutral position. This mechanism is inclosed by a metal hood fitting over the top of the diaphragm. Where regulation of the stoker and draft fans is desired in addition to damper control, a second control unit functioning under variations in steam pressure, is required. These two control units, of course, may be attached to an entire battery of boilers.

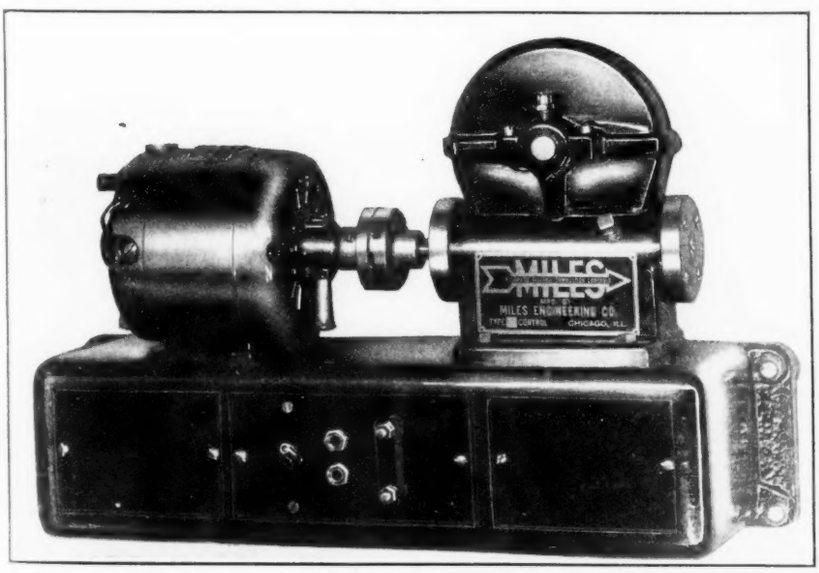


Fig. 1—Power unit of Miles automatic electric control

Ball-Bearing Hanger For Elevator Doors

ELEVATOR hoistway landing doors must operate easily or, particularly when they are operated by hand, the operators will be unable to make their schedules. Where the hoistway doors are hard to handle, it may be found difficult to keep good operators on the cars. Even those that can be had, will use hard operating doors as an excuse for not maintaining their schedules and for neglecting their work.

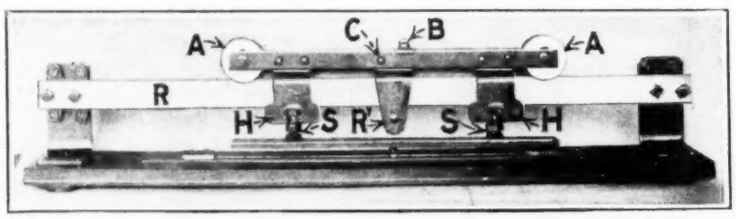
On the earlier types of hoistway landing doors the hangers were rather crude and unsuited to the service. The hangers in many cases were not heavy enough to stand up under service conditions and were equipped with sleeve-type bearings in the sheaves. As a result these doors were difficult to handle and to maintain.

To overcome the earlier defects, a great deal of engineering work has been done, out of which has developed the ball-bearing hanger of simple and substantial construction. One of the latest of these developments is the new hanger recently placed on the market by Franz A. Boedtcher, 442 West 42nd St., New York City, and shown in the full-sized model Fig. 1. Each door is carried on two ball-bearing sheaves *A*. The sheaves are about two inches in diameter and the ball bearings are totally inclosed so that they require no attention. The sheaves are supported between the ends of two parallel bars, from which the door is carried by the castings *H*. The bars, sheaves and hangers castings are assembled to form a rigid fixture, to prevent any twisting action that might cause binding in the operation of the door.

The door is supported at only two points by the adjusting screw *S*. This arrangement makes it easy to adjust the doors and insures each screw carrying its proper share of the door's weight. The door, with its hanger, runs on a rail *R*, $\frac{1}{2}$×1$\frac{1}{2}$ in. cross-section. An elevator landing door supported on one of the new ball-bearing hangers is shown in Fig. 2.

Power-operated doors have a tendency to lift one of the hanger sheaves off the supporting rail and cause binding. This uplifting of the doors is particularly pronounced where they are opened at high speed, and is caused by the bottom of the doors being accelerated faster than the top. In the new hanger this has been provided against by a roller *R'* supported, under the rail, from between the two sheave bars. This roller's support is pivoted at *C*. By means of an adjusting screw *B* the roller can be adjusted to a close clearance with the rail and locked into place by two nuts.

Through the failure of a hanger, landing doors have been known to come off their rails and fall down the hoistway. This has been provided against in the hanger, Figs. 1 and 2, by making the rear sheave bar wide enough to come down back of the guide rail. Even if both sheaves were to fail, which probably never would happen, the hanger could not get off the rail. There is no way that the hanger can be taken off the rail without first removing the rail from its supports and running the hanger off one end. All parts of the hanger are either malleable-steel castings or wrought steel.



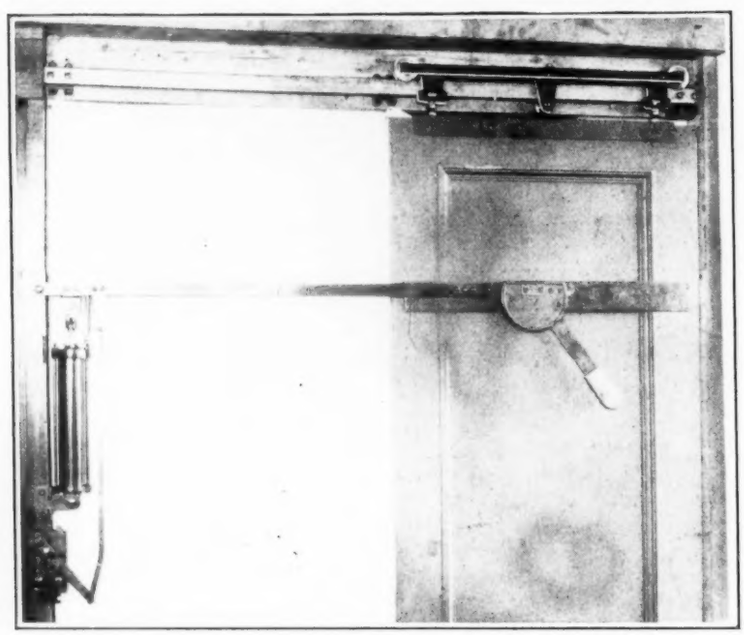
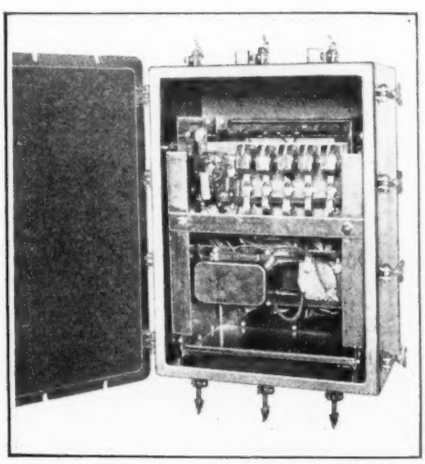


Fig. 1 (Above)—Elevator-landing door hanger. Fig. 2 (Below)—Elevator door carried on a hanger of the type shown in Fig. 1

G. E. Boiler-Plate Enclosing Cases for Motor Starters

DUST-TIGHT, boiler-plate enclosing cases for wall-mounted starters are announced by the General Electric Co., Schenectady, N. Y. The cases have been developed for use in dusty places, such as cement mills, cotton mills, coal mines and similar installations, also for use where protection against steam or fumes is necessary, such as in paper mills.



Compensator installed in a boiler-plate dustproof case

The cases are constructed of $\frac{1}{4}$-in. boiler-plate steel with welded joints. The front is covered by a boiler-plate door which swings on interchangeable hinges, opening either to the right or the left. This door is clamped against the machined surface of the case by means of thumbscrews. A vellumoid gasket is cemented to the case to give a dust-tight fit between the cover and the case proper. Conduit openings are provided for bringing the leads to the case. In the figure is shown a case with the cover open and containing an automatic compensator. The thumbscrews for clamping the cover in place can be seen around the edges of the case.

NEWS *of the* FIELD

Iron and Steel Division of A. S. M. E. Launches First Annual Meeting

Schwab, Dow, Abbott and Others Speak at Banquet—Technical Session of Wide Interest—Many Plants Inspected—Future Unity and Co-operation Seen

MANY eminent engineers and leaders in the steel industry concerned with the problems of fuels, power, alloys, iron and steel, headed by such men as Charles M. Schwab, Alex Dow, president of the Detroit Edison Company, and William L. Abbott, chief

Charles M. Schwab

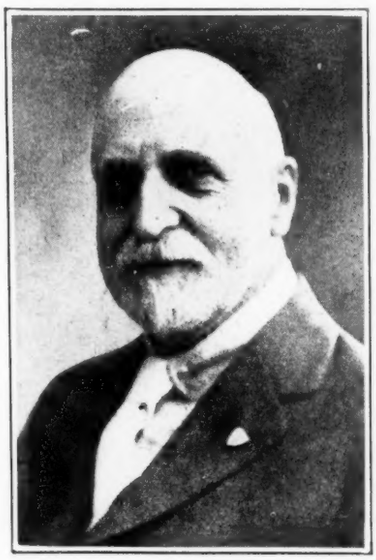
operating engineer of the Commonwealth Edison Company, Chicago, convened for the first annual meeting of the Iron and Steel Division of the American Society of Mechanical Engineers held at the Hotel Ohio in Youngstown, Ohio, Nov. 10.

Gathered under the joint auspices of the Youngstown Engineers Club and the Cleveland and other near-by sections of the A.S.M.E., more than 800 engineers attended the sessions of the day and the banquet which concluded the program in the evening.

At the morning session two papers were read: "Super Refractories," by C. M. Phelps, director of research and tests, of the Refractory Fellowship, Mellon Institute, Pittsburgh, and "Development of Four-High Rolling Mills," by F. C. Biggert, Jr., president of the United Engineering & Foundry Company, Pittsburgh. Discussion of the former paper was limited to verbal impressions, considering, chiefly, present and future developments. Through his contribution, Mr. Biggert explained briefly the advantages derived by the use of backing-up rolls and cluster mills, and the conditions coming into play in the roller bearings, together with their types and methods of adjustment.

President-elect Alex Dow and M. J. Terman, of the Babcock & Wilcox Company, responded with short talks bearing directly on the phases peculiar to their experience and observations. The paper on "Four-High Rolling Mills" was supplemented in a paper by Floyd Jones of the E. W. Bliss Company, and others.

Following the banquet in the evening in the ballroom of the Hotel Ohio, Charles M. Schwab, president of the American Society of Engineers and



Alex Dow

chairman of the board of the Bethlehem Steel Corporation, led the speakers with a short address. Mr. Schwab was followed by James A. Campbell, president of the Youngstown Sheet & Tube Company, and Alex Dow, president of the Detroit Edison Company. C. S. Robinson, vice-president of the Youngstown Sheet & Tube Company, served as the chairman of the evening.

Those attending the meeting enjoyed a variety of choice in the selection of plants to visit for inspection. Among those industrial centers were the Campbell Works of the Youngstown Sheet & Tube Company, the Republic Iron & Steel Company, the Truscon Steel Company, the Carnegie Steel Company, the General Fireproofing Company and the Trumbull Steel Company of Warren, Pa.

The following organizations co-operated to make the meeting a success: The Buffalo Engineering Societies; the Cleveland Engineering Society; the Engineering Society of Western Pennsylvania; the Lehigh Valley Engineering Club; and the Technical Federation of Erie.

Need for co-operation and unity, both in the business and technical sense, was stressed upon all attending this first national gathering of the division. That a local section of the A.S.M.E. will soon be established was the hopeful impression permeating the meeting.

Canadian Water Power Rights Up for Court Decision

The Provinces of Ontario and Quebec discussed their power development problems before a conference of provincial premiers at Ottawa, Ontario, Nov. 10, and strongly urged that the question of the respective rights of the federal and provincial governments in the matter of water power in navigable and interprovincial streams be referred to the courts for decision.

The view was expressed by Premier Taschereau of Quebec that the beds and shores of large streams belonged to the provinces, and that the federal government had taken the opposite view, while the Provinces of Ontario and Quebec were awaiting a decision in the matter, large quantities of power going to waste. The Premier declared that so far as the development of power was concerned the provinces could do better than the Dominion, inasmuch as they had control of the natural resources and could sell their water power and timber limits at the same time.

Hon. Ernest Lapointe, federal minister of Justice, declared that in consideration of the magnitude of the issue it would require further consideration by the federal Cabinet. It is understood, however, that the whole matter will be referred to the courts, and the most important phase now is a decision as to the form of the reference, so that no part of the issue will be omitted.

Shipbuilding Concern Forms Firm for Heating Products

The Staten Island Shipbuilding Company, which for more than a quarter of a century has been active in building commercial ships on the Atlantic Coast, has formed a division for the manufacture of heat transfer apparatus.

These products are not a new line with the company. This type of equipment has been manufactured at the plant for more than thirty years.

The line consists of equipment including water storage heaters, feed water heaters, bleeder heaters, waste heat extractors, preheaters, condensers, evaporators, brine coolers, oil heaters, oil coolers, humidifiers, tanks, piping, including bends of all materials, pumps, fabricated plate ware, and galvanized products.

The personnel of Heat Transfer Products, Inc., consists of men widely known for their achievements in the industry. The chairman of the board is William J. Davidson, who is president of the Staten Island Shipbuilding Company.

PERSONNEL INCLUDES:

George T. Jacocks, former vice-president and works manager of the Whitlock Coil Pipe Company of Hartford, Conn., has been elected president and general manager of this company.

Sylvan J. Crooker, who for many years has been connected with the United States Bureau of Standards and United States Bureau of Mines, also as chief engineer for the Whitlock Coil Pipe Company, has been elected vice-president in charge of engineering.

Walter S. Ogilvy has been elected vice-president in charge of manufacture, also as secretary of the company. Mr. Ogilvy was formerly superintendent of the Beach Division of the Whitlock Coil Pipe Company.

George H. Bates, the present treasurer and general manager of the Staten Island Shipbuilding Company, will serve as treasurer for the new company.

The main plant of the company is located at Mariners Harbor, Staten Island, New York City.

Connecticut's Power Slightly Over Last Year's

Connecticut public utility plants generated 105,060,000 kw.-hr. during September, according to a report just made public by the Department of the Interior.

Of this amount, 17,941,000 kw.-hr. were derived from water power and the rest, 87,119,000 kw.-hr., from fuel energy. The amount of power generated in the State in September was four per cent. more than that of the same month last year.

Plants in all of New England generated 442,173,000 kw.-hr., of which 135,609,000 kw.-hr. were derived from water power and 312,664,000 kw.-hr. from fuel energy. The amount of coal burned was 233,809 tons, and the fuel oil consumed, 76,439 barrels.

Massachusetts produced 207,838,000 kw.-hr. of power; Vermont, 21,375,000; Maine, 49,227,000; New Hampshire, 17,414,000, and Rhode Island, 47,357,000 kw.-hr.

H. W. How Now Consulting for Struthers-Wells Co.

H. W. How, formerly chief engineer of the Buffalo Foundry & Machine Company, has been appointed chief for the Struthers-Wells Company, Warren, Pa., as consulting engineer.

H. W. How

Before the war Mr. How was in charge of the machine and plate shop of the Thomas C. Basehor Company of Baltimore. Later he was engaged by the Southern Menhaden Company, Jacksonville, Fla., to design and construct a complete process plant for the manufacture of fish fertilizer and oil. During the war he was in the U. S. Navy for thirty-one months as chief engineer officer, and as manager of the Naval Engineering Experiment Station at Annapolis. For the past five years he has been chief engineer for the Buffalo Foundry & Machine Company, Buffalo.

The Struthers-Wells Company have planned a manufacturing program for the coming year, including a complete line of heat exchangers, and a new series of rotary air and direct heat driers in standard sizes and construction.

Present plans also embrace the development and standardization of a high velocity evaporator, a high temperature heat exchanger system for process work requiring temperatures higher than that obtainable with steam and a new system of evaporation and fusion for inorganic products requiring elevated temperatures for finishing.

Industrial Research Doubles Expenditure in Six Years

About $200,000,000 annually is being spent in the United States for industrial research by industrial corporations and by the federal government, with industry spending two dollars for every one spent by the government, according to information collected by the National Industrial Conference Board, incidental to a study of industrial organization.

So rapid has been the extension of research work as a necessary auxiliary to industrial management and technique that, whereas in 1921 only 578 companies were known to maintain research departments or laboratories, more than 1,000 concerns have organized research divisions in operation at the present time. In addition, 70 trade associations are spending about $15,000,000 a year in research, and 152 colleges and technical schools about $1,500,000. Furthermore, there is much technical research work being carried on in connection with industrial production, the costs of which are not segregated as such but are accounted for as part of production costs and hence are not included in the total sum here given.

WISDOM OF RESEARCH PROVED BY MARKED GROWTH

Industries whose research expenditures were largest five years ago are those which have scored the greatest relative growth since then, according to the data submitted to the Conference Board. The greatest amount spent by any one manufacturing company among those from which the Board has detailed statements in 1926 was more than $5,250,000, while a public utility corporation spent approximately $13,000,000 within the year. Manufacturing companies were found to spend on an average from one to three per cent of the gross amount received from sales on research.

Urges Foreign Fuel Experts To Attend Second Conference

The Carnegie Institute of Technology is extending to 26 governments in Europe, South America and Asia, invitations to send one or more delegates to the second International Conference on Bituminous Coal which will be held at this institution in November, 1928.

The advisory board of the second conference is made up of E. M. Herr, Samuel Insull, Frank B. Jewett, Otto Kahn, George E. Learned, A. W. Mellon, Auguste G. Pratt and Charles M. Schwab.

In addition to the official delegates invited the Carnegie Institute of Technology will welcome scientific and technical men, especially those interested in the progress of fuel technology.

Activity Falls Off in Boiler Manufacturing Plants

During October the boiler manufacturing industry of the country continued the downward trend in activities which started in September.

The October rate of productive activity was about 5.5 per cent under September, and 15 per cent under the activity recorded in October last year. The rate of activity during October was the lowest recorded since August, 1926. Conditions in the industry as a whole, however, were spotty, some companies reporting slightly increased activities over September, while the majority reported a decrease under September.

The index of activity in the boiler manufacturing industry based upon electrical energy consumption stands at 93.4 for October, as compared with 99.2 for September. Comparative indexes of productive activity referred to the monthly average activity for the year 1925 as 100, and adjusted for number of working days are as follows:

October, 1927	93.4
September, 1927	99.2
August, 1927	103.6
October, 1926	109.8
October, 1925	128.7
Average first six months of 1927	104.3
Average for full year 1926	105.2

Decrease in Line With General Conditions

The decrease in productive activities in the boiler manufacturing plants under last year is in line with general conditions existent in the metal-working industry as a whole. In October the rate of productive activity in the ferrous and non-ferrous working plants of the nation was 10.6 per cent under October, 1926, and the activities of the steel plants and rolling mills which branch of the metals industry group furnishes the raw products to the metal working branch, reported an October activity 9.2 per cent under 1926.

In spite of this lowered rate in the activities of the metals group of industries, other primary industries, such as leather, textiles, lumber, automobiles, food and rubber, all reported activities over those of 1926, the resultant activity for industry as a whole being slightly over October of last year. There is good reason for believing that general industrial activity during the remainder of 1927 will be slightly under that of 1926.

New U. S. Commerce Department to Aid Trade Bodies

Recognizing the increasing importance of the extension industrial group effort, the Chamber of Commerce of the United States has created a new department to work with trade organizations. In announcing this, Lewis E. Pierson, president of the National Chamber, made it known that the head of the department would be Dr. Hugh P. Baker, an economist, who as head of the American Paper and Pulp Association, has won recognition as one of the country's leading authorities on trade associations. Dr. Baker will assume his duties on Feb. 1.

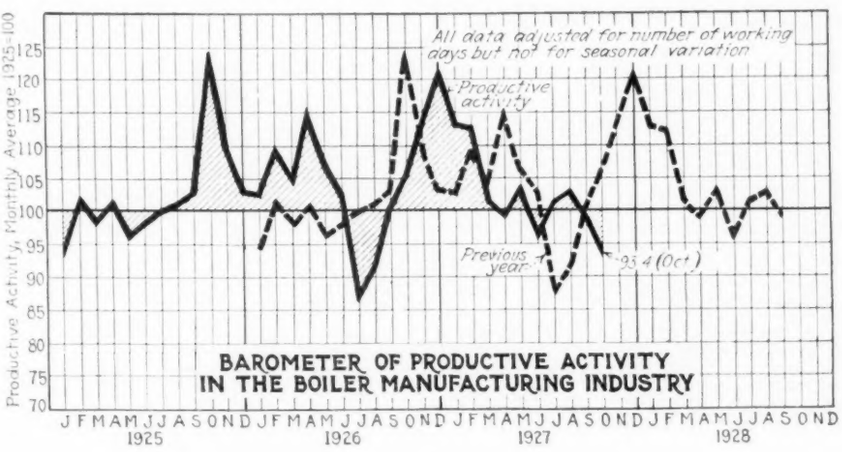
Entering New Fields

The purpose of this move is to coordinate the expanding relations of the National Chamber with the more than six hundred trade associations in its membership and to lend assistance to the many other industrial groups now laying out their future program of organization. Mr. Pierson pointed out that trade associations are entering many new fields, opened up by the increasing competition between industrial groups.

To Promote Self-Regulation

"In seeking new and enlarged markets for their members," Mr. Pierson explained, "trade groups are more and more interested as groups in transportation questions; elimination of excess varieties; in standardization; in patents; uniform cost accounting; depreciation and arbitration; trademarks; collective buying; bonding and insurance. On the other hand, in an effort to protect industry from within and, indeed, the business of the country, trade associations are interested in credits; collections, fraudulent bankruptcy; trade ethics, trade practices; tariffs and taxation."

Perhaps most important, President Pierson continued, will be the promotion of the movement already under way looking toward self-regulation by business groups, which has as its aim the elimination of economic wastes in every form. To that end, the department will co-operate with the Federal Trade Commission and other governmental agencies.


All data adjusted for number of working days but not for seasonal variation
Productive activity
Previous year
93.4 (Oct.)
Productive Activity, Monthly Average 1925=100
125
120
115
110
105
100
95
90
85
80
75
70
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1925
1926
1927
1928
BAROMETER OF PRODUCTIVE ACTIVITY IN THE BOILER MANUFACTURING INDUSTRY

Personal Mention

John W. Nostrand resigned his position Nov. 1 as power engineer for the Jersey Central Power & Light Company, Asbury Park, N. J., to enter the condenser department of the Worthington Pump & Machinery Corporation.

Dean C. O. Ruggles of the School of Commerce and Administration of the Ohio State University has secured a year's leave of absence to undertake a survey of public utility courses and studies conducted in colleges and universities throughout the country.

M. T. Lindhagen, managing director of the A. B. Ljungstroms Angturbin of Stockholm, Sweden, returned on the Aquitania Nov. 16 after a three weeks' visit studying power plant conditions in this country. Mr. Lindhagen is secretary of the combined engineering societies of Sweden and is chairman of their committee on power test codes. He is a well-known consulting engineer and an authority on steam turbines.

Prof. George Carl Shaad, head of the department of electrical engineering at the University of Kansas, was appointed dean of the School of Engineering and Architecture Nov. 2. Dean Shaad, who succeeds the late Dean Perley F. Walker, came to the University of Kansas from the Massachusetts Institute of Technology in 1909. He is a member of the A.S.M.E., A.I.E.E., Illuminating Engineering Society and the Kansas Engineering Society.

Alex H. Luedicke, supervising engineer for the Gridley Dairy Company, Milwaukee, and member of the A.S.M.E., has been elected president of the Engineers' Society of Milwaukee for the coming year. In 1919 Mr. Luedicke became connected with the Gridley Dairy Company as supervising engineer in charge of all power plants, construction and maintenance. He has also done considerable work in connection with the use of exhaust steam in dairy process work.

Society Affairs

A.S.M.E., St. Louis, Dec. 2, Hotel Roosevelt, at 6:30 p.m.; dinner for past chairman of the St. Louis local section.

A.S.M.E., Green Mountain, Dec. 1, Springfield, Vt., at 7:15 p.m.; talk on compressed air and its uses by F. D. Holdsworth, engineer, Sullivan Machinery Company.

A.S.M.E., Buffalo, Dec. 13, Hotel Statler, at 8:00 p.m.; "The Present Standing of Various Standards Now Being Developed for Valves and Fittings for High Pressure Steam Service," by F. H. Morhead, chief engineer of the Walworth Company. There will also be slides showing in detail the design of high pressure valves and fittings for application to service requirements as outlined in various standards.

American Refractories Institute will hold meetings at the Hotel Chase, St. Louis, Mo., Dec. 6-7. Papers of interest will include "Dry Grinding of Refractories," by Mr. J. M. Gallaher, works manager, Clearfield Machine Company, Clearfield, Pa., and "Burning Refractories with Stokers," by Massillon Refractories Company, Massillon, Ohio. Inquiries concerning sessions should be directed to the secretary of the American Refractories Institute, 2202 Oliver Building, Pittsburgh.

A.S.M.E., Metropolitan Section, Aeronautic and Oil and Gas Power division meeting, Nov. 22, at 8 o'clock in the Engineering Societies Building, 29 West 39th St., New York City. "The Oil Engine and Aeronautics," Commander E. E. Wilson, N. S. N., head of engineering section, Bureau of Aeronautics, Navy Department, Washington, D. C.; "Heavy Oil Engines for Aircraft," D. R. Pye, deputy director of scientific research, British Air Ministry, and "Experiments in Fuel Injection for Aeronautical Engines," W. F. Joachim, National Advisory Committee for Aeronautics.

Business Notes

Harbison-Walker Refractories Company announce the letting of contracts for four direct-fired tunnel kilns, including steel and concrete buildings and necessary equipment. These kilns will be identical in type and size, two to be built at the Templeton, Pa., plant and two at Clearfield, Pa. They will be used in burning fire clay brick only.

Leipzig Trade Fair, Inc., has appointed Herbert A. Johnson as New York manager, succeeding the late E. A. Boettcher, at 630 Fifth Ave., New York City.

The Ohio Brass Company has announced the decision to create an executive branch in New York City, to cover New England and the territories served by the present New York and Philadelphia sales offices of the company. This change will be made effective about Jan. 1, with Frederick Attwood in charge.

The Reading Iron Company announces that L. J. Melson, who formerly represented the company in the South, has been appointed district sales representative in the Cincinnati office, 618 Dixie Terminal Building. His work in the South, both from a buyer and seller viewpoint, earned him this promotion.

The Blaw-Knox Company announces the appointment of the following distributors for Blaw-Knox Security open flooring, electro-forged grating and steps: Worden-Allen Company, Milwaukee, Wis.; Wilson-Weesner-Wilkinson Company, Knoxville, Tenn., and Jas. A. Hall, 1525 Esperson Building, Houston, Texas.

Coming Conventions

American Boiler Manufacturers Association, winter meeting, Hotel Cleveland, Cleveland, Feb. 7; A. C. Baker, sec., 801 Rockefeller Bldg.

American Engineering Council, annual meeting will be held in Washington, D. C., Jan. 9-11; L. W. Wallace, executive secretary, 26 Jackson Place, N. W., Washington, D. C.

American Institute of Electrical Engineers, Great Lakes District regional meeting at the Hotel Drake, Chicago, Nov. 28-30, Address J. E. Kearns, chairman registration committee, General Electric Company, 230 South Clark St., Chicago.

American Society of Heating & Ventilating Engineers, hold general meeting at Hotel Pennsylvania in New York City, Jan. 23-26; A. V. Hutchinson, sec., 29 W. 39th St., New York.

American Society of Refrigerating Engineers, annual convention in New York, Dec. 5-7; W. H. Ross, sec., 37 W. 39th St., New York City.

American Water Works Association. Annual meeting, Hotel Fairmont, San Francisco, June 11-16; W. M. Niesley, 170 Broadway, New York City.

American Society of Mechanical Engineers, convention during week of New York Power Show, New York City, Dec. 5-10; Calvin Rice, sec., 29 West 39th St., New York City.

Midwest Power Conference and Exhibition, at Chicago, Feb. 14-17; G. E. Pfisterer, sec., 53 West Jackson Blvd., Chicago.

National Association of Practical Refrigerating Engineers. Eighteenth annual convention and educational exhibition in Civic Convention Hall and headquarters Hotel Whitcomb, San Francisco, Calif., Nov. 29 to Dec. 2. H. Fox, 5707 W. Lake St., Chicago, Ill.

National District Heating Association, annual meeting in May; D. L. Gaskill, sec. 112 West 4th St., Greenville, Ohio.

New York Power Show (National Exposition of Power and Mechanical Engineering) will be held at the Grand Central Palace, New York City, Dec. 5-10. Address inquiries to the International Exposition Co., Grand Central Palace.

National Engineers' Beneficial Association, Fifty-third annual convention will be held in Washington, D. C., Feb. 14. Headquarters to be announced hereafter; Albert L. Jones, secretary treasurer, 313 Machinists' Bldg., Washington, D. C.

Power Transmission Association. Annual meeting, Hotel Commodore, New York City, Dec. 7; W. S. Hays, Sec., Drexel Building, Philadelphia.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Nov. 9 1927
Pool 1	New York	$2.35@$2.75
Smokeless	Boston	1.39
Clearfield	Boston	1.60@1.85
Somerset	Boston	1.80@2.00
Kanawha	Columbus	1.40@1.60
Hocking	Columbus	1.50@1.75
Pittsburgh	Pittsburgh	1.75@1.90
Pittsburgh gas slack	Pittsburgh	1.10@1.25
Franklin, Ill.	Chicago	2.25@2.50
Central, Ill	Chicago	2.00@2.25
Ind. 4th Vein	Chicago	2.00@2.35
West Ky.	Louisville	1.00@1.50
S. E. Ky.	Louisville	1.25@1.75
Big Seam	Birmingham	1.65@2.00
Anthracite (Gross Tons)		
Buckwheat No. 1.	New York	2.90@3.25
Buckwheat No. 1.	Philadelphia	3.00@3.75
Birdseye	New York	1.60

FUEL OIL

New York—Nov. 17, light oil, tank-car lots, 26 deg. Baumé, 5c. per gal.; 28 deg., 5¼c. per gal., f.o.b. Bayonne, N. J.

St. Louis — Oct. 31, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.55 per bbl.; 26@28 deg., $1.60 per bbl.; 28@30 deg., $1.65 per bbl.; 30@32 deg., $1.70 per bbl.; 32@36 deg., gas oil, 4.273c. per gal.; 38@40 deg., 5.23c. per gal.

Pittsburgh—Nov. 8, f.o.b. local refinery, 30@34 deg., fuel oil, 4½c. per gal.; 36@40 deg., 4¾c. per gal.

Philadelphia—Nov. 16, 26@30 deg., $1.60@$1.66 per bbl.; 13@19 deg., $1.56@$1.62 per bbl.; 22 plus, $1.79@$1.85 per bbl.; 27@30, $2.10@$2.16 per bbl.

Cincinnati — Nov. 15, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.9c. per gal.; 26@30 deg., 5.15c. per gal.; 30@32 deg., 5½c. per gal.

Chicago—Nov. 12, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 80@85c. per bbl.; 26@30 deg., 90c. per bbl.; 30@32 deg., $1.05 per bbl.

Boston—Nov. 15, tank-car lots, f.o.b., 12@14 deg. Baumé, 4.2c. per gal.; 28@32 deg., 5¾c. per gal.

Dallas—Nov. 12, f.o.b. local refinery, 26@30 deg., $1.45 per bbl.

Trade Catalogs

IRON PIPE—A. M. Byers Company, Pittsburgh, Pa., in Bulletin No. 4 treats of Spiral Stripe wrought iron pipe used in various kinds of construction, especially in modern practice governing power-house construction.

HEAT TRANSFER—The Dampney Company of America, Hyde Park, Boston, in its recent bulletin No. 1133, gives the results obtained by the National Physical Laboratory of London on determinations of the heat transfer from tubes to which APEXIOR protective coatings had been applied.

CENTRIFUGAL BLOWERS AND COMPRESSORS—The De Laval Steam Turbine Company, Trenton, N. J. Centrifugal blowers and compressors as used in blast furnaces, steel plants and byproduct coke-oven plants are described, together with pumps, turbines and speed reducers, in Bulletin E-1107 distributed by the De Laval Steam Turbine Company, Trenton, N. J. Centrifugal blowers and compressors are built with various numbers of stages, ranging from single-stage blowers for blowing air through the fuel beds of water gas generators, to multistage compressors capable of supplying air at 100 lb. pressure per sq.in. Centrifugal compressors are extensively used for exhausting gas from byproduct coke ovens and for boosting the pressure of gas for long distance transmission. De Laval centrifugal blowers and compressors are driven by De Laval steam turbines or by electric motors. Speed-increasing gears are sometimes used in order to utilize standard speed motors.

INSULATION FOR FURNACES — Johns Manville Corporation, New York, has issued a small illustrated leaflet describing Superex insulation for furnaces and other high temperature equipment where the material applied must resist temperatures between 600 deg. and 1,500 deg. F. This product is a combination of refractory material of good insulating value and asbestos fibre, bonded together. It has a low thermal conductivity and will withstand temperatures up to 1,500 deg. F. with negligible shrinkage. Weighing approximately 24 lb. per cubic foot, it possesses considerable strength.

WATER SOFTENING—The Paige & Jones Chemical Company, Hammond, Ind., has issued a new bulletin, "Softened Water—The Universal Need," which details the various benefits derived from softening water supplies and also describes the different types of water softening equipment as manufactured by the Paige & Jones Chemical Company.

STEEL FITTINGS AND FLANGES—The Stockham Pipe & Fittings Company, Birmingham, Ala., recently published a catalog descriptive of cast-steel fittings. This catalog is a complete reference book, containing not only a detailed description of Stockham steel fittings and flanges, but tables of temperature and pressure ratings and tables of dimensions. Stockham steel fittings are made from electric steel for working steam pressures of 150, 300, 400, 600, 900 and 1,350 lb., in accordance with the new American Standards. Chemically and physically, they actually exceed the specifications of the American Society for Testing Materials. Catalogs will be furnished upon request to Birmingham.

NEW PLANT CONSTRUCTION

Calif., Long Beach—City is having plans prepared for the construction of pumping stations, etc., for sewage treatment works. Estimated cost $500,000.

Calif., Redlands—Mountain Ice Water Co., C. Gabriel, is having plans prepared for the construction of an ice and cold storage plant at Tennessee and Colton Aves. Estimated cost $50,000. H. E. Jones, Katy Bldg., San Bernardino, is architect.

Colo., Pueblo—R. Jewel, Central Blk., is having plans prepared for a hotel and office building at Fourth and Main Sts. Estimated cost $1,000,000. E. C. Groves, 1982 Broadway, Denver, is architect.

Fla., Tampa—Tampa Electric Co., P. O. Knight, Pres., Tampa and Cass Sts., plans to expend $5,000,000 for the construction of a power plant at Hookers Point. Stone & Webster, 147 Milk St., Boston, Mass., are engineers and contractors.

Ga., Columbus — Columbus Electric & Power Co., 1151 Broad St., plans additional unit, 15,000 kw. capacity at Bartletts Ferry power plant. Stone & Webster, 147 Milk St., Boston, Mass., are engineers.

Ill., Chicago—Hammar & Girton, 18 West Kinzie St., is having plans prepared for a 13 story apartment building including refrigeration system, elevators, etc., at 1215 Granville Ave. Estimated cost $750,000. Private plans.

Ill., Chicago — Holabird & Roche, 104 South Michigan Ave., Archts., will receive bids until Dec. 3 for the construction of a 13 story hospital and nurses home, including refrigeration and ventilation systems, elevators, etc., at East Superior St. and Fairbanks Ct., for Passavant Memorial Hospital, 26 West Erie St. Estimated cost $2,000,000.

Ill., Chicago — Produce Terminal Cold Storage Co., c/o Henchin & McLaren, 1637 Prairie Ave., Archts., is having plans prepared for a cold storage plant at 15th Pl. and Throop St. Estimated cost $2,000,000.

Ill., Chicago — Syndicate, c/o Frankenstein & Co., 110 South Dearborn St., awarded contract for the construction of a 6 story apartment, stores and office building at Michigan Ave. and Chestnut St., to Heggeman-Harris Co., 431 North Michigan Ave. Estimated cost $1,250,000.

Ill., East St. Louis — Highland Dairy Farms Co., B. F. Tschannen, Secy., 4321 Chouteau Ave., awarded contract for the construction of a milk distributing plant including refrigeration system, cooler building, etc., at Ridge and Wimmer Sts., to Fruin-Colnon Construction Co., Merchants-Laclede Bldg. Estimated cost $150,000.

Ind., Chrysler—Thomas E. Murray, Inc., 55 Duane St., New York, N. Y., Engr., is installing an 800 hp. power unit, stokers, etc., in electric power plant for Chrysler Motor Co., Highland Park, Mich. Estimated cost $200,000. Two more units will be installed later.

Ia., Manning—Manning Light Co. is having plans prepared for the construction of an electric light plant. Estimated cost $200,000. Private plans.

La., New Orleans—Chicago Syndicate plans the construction of a hotel at Bayou St. John St., here. Estimated cost $2,000,000. B. H. Marshall, 612 Sheridan Rd., Chicago, Ill., is architect.

Md., Baltimore—Title Guarantee & Trust Co., St. Paul and Lexington Sts., is having plans prepared for a 12 story hotel including steam heating system, etc., at St. Paul and Eager Sts. F. A. Fletcher, 13 West Franklin St., is architect.

Mass., Attleboro—City plans waterworks improvements including pumping station, mains, etc. Estimated cost $200,000. M. Taber, City Hall, is engineer.

Mass., Brockton — Cudahy Packing Co., 37 Merchants Row, Boston, is receiving bids for the construction of a refrigeration plant at North Montello St., here. Estimated cost $50,000. Private plans.

Mass., Dorchester (Boston P. O.)—Transit Dept., 1 Beacon St., Boston, will receive bids until Nov. 29 for the construction of a heating plant at Fields Corner, here. Estimated cost to exceed $50,000.

Mass., Quincy (Boston P. O.)—Granite City Ice Co., Inc., 550 Adams St., awarded contract for the construction of an ice plant to W. A. Sanborn, 79 Milk St., Boston.

Mass., Roxbury (Boston P. O.)—Edison Electric Illuminating Co., 39 Boylston St., Boston, is receiving bids for the construction of an electric sub-station on Humboldt Ave., here. Estimated cost $40,000. Former bids rejected.

Mass., West Springfield (Springfield P. O.)—Boston & Albany R.R., South Station, Boston, is receiving bids for the construction of a power plant here. G. A. Kirley is chief engineer.

Mich., Dearborn—City will soon award contract for a sewage treatment plant including pumping station, electrically operated centrifugal pump, etc. Estimated cost $100,000. R. H. Erley is engineer.

Mich., Detroit—A. Kahn, 1000 Marquette Bldg., Archt., will receive bids until Dec. 1 for the construction of a 25 story office building including steam heating, and ventilation systems, boilers, elevators, etc., on West Grand Blvd., for New Center Development Co., General Motors Bldg.

Mich., Marine City—City plans the construction of a new waterworks system including filtration plant, pump house, electrically driven pump, etc. Estimated cost $100,000. A. Friederichs, mayor.

Minn., Austin — City awarded contract for the construction of a boiler house to Tapager Construction Co., Albert Lea. Estimated cost $49,467.

Minn., Minneapolis—Nordic Hotel Assn., G. Eide, Secy., 1614 East 34th St., plans the construction of an 18 story hotel at Marquette Ave. and 10th St. Estimated cost $2,500,000. Sund & Dunham, 512 Essex Bldg., are architects.

Mo., Kansas City — Southwestern Bell Telephone Co., Telephone Bldg., will soon award contract for a 13 story addition to office building including ventilation system, boilers, elevators, etc. Hoit, Price & Barnes, 800 Davidson Bldg., are architects.

Mo., St. Louis — Bd. of Public Service will soon award contract for the installation of a refrigeration plant in City Morgue. L. R. Bowen, 301 City Hall, is engineer.

St. Louis, Mo.—Thomas E. Murray, Inc., 55 Duane St., New York, N. Y. Engr., is installing motor auxiliary coal and ash handling equipment in proposed power unit for Chevrolet Motor Co., 3044 West Grand Blvd., Detroit, Mich. Estimated cost $130,000.

Mo., St. Louis—Herbert M. Edmunds, 114 North Seventh St., will build a 16 story apartment building, including steam heating and electrical refrigeration systems, etc., at 4481 West Pine Blvd. Estimated cost $1,000,000. Owner is general contractor.

N. J., Camden — Camden Rail & Harbor Terminal Corp. is having plans prepared for the construction of a cold storage plant at Front and Kaighn Aves. Estimated cost $750,000. Moores & Dunford, 110 East 42nd St., New York, N. Y., are architects.

N. J., East Orange—D. S. Koggan, 418 15th St., Paterson, is having plans prepared for a 10 story apartment building including steam heating system, boilers, elevators, etc. at 238 Harrison St. here. Estimated cost $500,000. A. Haenichen, 126 Market St., Paterson, is architect.

N. J., Jersey City—Universal Securities Co., H. W. Runyon, Pres., 50 Journal Sq., is having sketches made for a 17 story hotel including steam heating system, etc., at 2861 Hudson Blvd. Estimated cost $5,000,000. Architect not announced.

N. J., Newark—Branford Building Co., c/o H. F. Clark, 38 Clinton St., Archt., is having plans prepared for a 22 story office building including steam heating system, boilers, elevators, etc. at Branford Pl. and Arlington St. Estimated cost $3,000,000.

N. J., New Brunswick—Public Service Corp., Terminal Bldg., Park Pl., Newark, is having plans prepared for the construction of a pumping station, etc. here. Estimated cost $40,000. Public Service Production Co., 80 Park Pl., Newark, is architect.

N. J., Paterson—Lee & Hewitt, 152 Market St., Archts., are receiving bids for the construction of a boiler house at Railroad and 4th Ave. for H. H. Brown & Sons, 15 4th Ave. Estimated cost $40,000.

N. J., Red Bank—Red Bank Hotel Co., C. A. Williams, Salz Bldg., will soon award contract for a 9 story hotel including steam heating system, boilers, elevators, etc. on Riverside Ave. Estimated cost $650,000. N. Harris, 20 Branford Pl., Newark, is architect.

N. Y., Brooklyn—Jones Construction Co., 136 Lawrence St., will build two 6 story apartment buildings at Nostrand and Linden Aves. Estimated total cost $2,000,000. Gronenberg & Leustag, 1385 Broadway, New York, are architects. Work will be done by separate contracts.

N. Y., Brooklyn—Syndicate, c/o Shampan & Shampan, 188 Montague St., Archts., is having plans prepared for a 6 story apartment at Bay Parkway and 83rd St. Estimated cost $800,000.

N. Y., Buffalo—Childrens' Hospital plans the construction of a dispensary building, maternity building, power house, etc., addition to nurses' home.

N. Y., Elmira—Wisner Park Corp. of Elmira, c/o J. J. Hassett, State Theatre Bldg., is having preliminary sketches made for the construction of an 8 story hotel at Main and Gray Sts. Estimated cost $1,140,000. G. B. Post, 101 Park Ave., New York, is architect.

N. Y., New York—B. Hoffman, 145 East 51st St., awarded contract for a 13 story apartment building at 132 East 79th St. to G. Richard Davis, 10 East 41st St. Estimated cost $750,000.

N. Y., New York—Montefiore Hospital, Gunhill Rd., had sketches made for the construction of a hospital. Estimated cost $800,000. Kohn & Butler, 56 West 45th St., are architects.

N. Y., New York—Solomon & Kahn, 475 Fifth Ave., will build a 15 story apartment building at Third Ave. and 79th St. Estimated cost $750,000. Gronenberg & Leuchtag, 1385 Broadway, are architects. Work will be done by separate contracts. Owner is general contractor.

N. Y., New York—Thirty Three Riverside Drive Inc., 2095 Broadway, is receiving bids for the construction of a 16 story apartment building including steam heating system, etc. at 31 Riverside Dr. Estimated cost $1,150,000. G. F. Pelham, 570 7th Ave., is architect. Work will be done by separate contracts. Owner is general contractor.

O., Cincinnati—American Druggist Fire Insurance Co., Mercantile Library, awarded contract for a 15 story office building on Central Parkway to Max Penker & Son, 123 Valencia St. Estimated cost $700,000.

O., Cleveland—City Ice & Fuel Co., c/o E. C. Balzhiser, 6611 Euclid Ave., awarded contract for an ice and cold storage plant at East 37th St. and Burwell Ave. to Bloom-Sinek Co., 33 South Clark St., Chicago, Ill. Estimated cost $600,000.

O., Toledo—Famous Players Lasky Corp., Paramount Bldg., New York, N. Y., awarded contract for a 4 story theatre and commercial building here to Lundoff-Bicknell Co., B. F. Keith Bldg., Cleveland, O. Estimated cost $1,500,000.

Okla., Fort Cobb—City plans an election Dec. 8 to vote $30,000 bonds for waterworks improvements including two wells, two deep well pumps and motors, etc. C. Riggins, Anadarko, is engineer.

Okla., Hooker—City, E. J. Barr, will soon award contract for waterworks improvements including two wells, two deep well pumps and motors, etc. Estimated cost $17,000.

Okla., Tulsa—J. E. Crosbie, Central National Bank Bldg., plans a 12 story office building on Main St. Estimated cost $700,000. Architect not selected.

Okla., Tulsa—A. C. Johnson, 309 National Bank of Commerce, plans the construction of an 11 story hotel at Main and 7th Sts. Estimated cost $700,000. Architect not selected.

Ore., Grants Pass—City plans the contruction of a new waterworks system including reservoir, filter plant and pumping station, etc. Estimated cost $400,000. Barr & Cunningham, Spalding Bldg., are engineers.

Frankford, Pa.—Thomas E. Murray, Inc., 53 Duane St., New York, N. Y., Engr., is installing a boiler, motor, turbine, condenser, etc., for C. H. Masland & Sons, Frankford, Pa. Estimated cost $10,000. Part of installation to be delayed until next spring.

Tenn., Memphis—Memphis Cold Storage Warehouse Co., 99 South Front St., had plans prepared for addition to cold storage warehouse. Estimated cost $25,000. E. L. Harrison, Fidelity Bank Bldg., is architect.

Tex., Fort Worth—Fort Worth Properties Co., c/o J. T. Jones, Houston, is having plans prepared for an 18 story office building at West 7th and Lamar Sts. Estimated cost $1,000,000. Architect not announced.

Tex., Lampasas—City plans an election Dec. 6 to vote $8,000 bonds for waterworks improvements including pumping equipment, etc.

Tex., Quitaque—West Texas Utilities Co., Abilene, is having plans prepared for the construction of a 15 ton ice plant here. Estimated cost $30,000. Adams & Adams, c/o Builders Exchange Bldg., San Antonio, are engineers. Machinery and equipment will be required.

Tex., San Antonio—City Ice Co., c/o C. S. Dowley, Mgr., 142 Camp St., is having plans prepared for the construction of a 50 ton ice plant at Pleasanton Rd. and Toudouze St. Estimated cost $75,000. Private plans. Work will be financed by Southland Ice Co.

Wash., Olympia—Hamma Hamma Paper & Power Co., E. M. Chandler, Pres., has been granted permit for water rights on the Hamma Hamma River and plans to expend $1,500,000 for development of electric energy for manufacturing and public service purposes. Plans include a dam to produce 19,000 hp., cost $480,000.

Ont., Toronto—Ramsey Stewart & Co., Northern Ontario Bldg., awarded contract for a 15 story hotel at Avenue Rd. and Bloor St. W. to Yolles & Rotenberg, 85 Richmond St. W. Estimated cost $2,000,000. Steam heating and refrigeration systems, elevators, etc. will be installed.

Equipment Wanted

Boiler, Superheater, Stoker, etc.—City of Rushville, Ind., is receiving bids for a 500 hp. water tube boiler, superheater and stoker.

Boilers, Superheaters, Coal Feeding Apparatus, etc.—Dept. of Public Works, Bureau of Water, E. G. Lang, Dir., City-County Bldg., Philadelphia, Pa., will receive bids until Nov. 23 for boilers, superheaters, coal feeding apparatus, etc., at Ross pumping station.

Generating and Distributing Equipment—Texas Power Corp., Sequin, Tex., will soon receive bids for generating and distributing equipment for proposed power plant. Estimated cost $1,000,000.

Motor—U. S. Engineer Office, Washington, D. C., is receiving bids for a 940 hp. d.c. motor for U. S. Dredge, "Fort Gage," St. Louis, Mo.

Pumps, etc.—Dept. of Public Works, R. W. Wolfe, Comr., Chicago, Ill., will be in the market for four 40,000,000 g.p.m. pumps for proposed pumping station. Estimated cost $1,000,000.

Pumps, Motors, Engines, Etc.—I. L. Christiansen, clk., City Hall, Muskegon, Mich., will receive bids until Nov. 25 for furnishing centrifugal pumps with motors either three 6 m.g.p.m. or one 3 m.g.p.m., one 6 m.g.p.m. and one 9 m.g.p.m., also one 225 hp. gasoline engine.

Water and Light Plant Equipment—City of Opelousas, La., plans to purchase equipment for proposed water and light plant. Estimated cost $50,000.

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